# CEREAL SCIENCE today

35c PER COPY | MARCH 1957 | VOLUME 2 • NUMBER 3

MAR 5 1957
THE LIBRARY

AN OFFICIAL PUBLICATION
OF THE
AMERICAN ASSOCIATION
OF CEREAL CHEMISTS

OF INTEREST THIS MONTH

COMMERCIAL RESEARCH
MODERN CHEMICAL ANALYSIS
A.A.C.C. PRELIMINARY PROGRAM

# REEL TYPE OVENS

## *For Your Test Baking*

- **INTERMEDIATE SIZE**

  Pictured below is an oven with a capacity of 12 1-lb. loaves or 24 pup loaves. Available in electric heated with Fenwal controls or gas fired with Robert Shaw controls. Shipping weight 1000 lbs. Table space 40" x 40".

  **Price $918.50 Net. F.O.B. Lincoln, Nebraska.**

- **STANDARD SIZE**

  **Capacity 8 1-lb. loaves or 16 pup loaves. This is our original Reel Oven. Specifications same as Intermediate, except for capacity. Shipping weight 800 lbs. Table space 40" x 40".**

  **PRICE $777.50 NET.**

- **LARGE SIZE**

  **Capacity 16 1-lb. loaves or 32 pup loaves. Similar specifications as other sizes except for width and necessary variations. Shipping weight 1260 lbs.**

  **PRICE $1010.50 NET.**

***AVAILABLE IN STAINLESS STEEL EXTERIOR AT EXTRA COST***

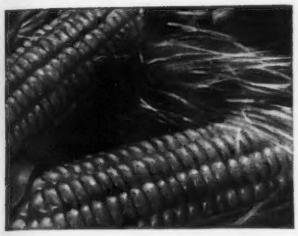
## PROMPT DELIVERY

**NATIONAL MFG. COMPANY**
LINCOLN, NEBRASKA

# The Vital Story of CORN ENRICHMENT

## (CORN MEAL—CORN GRITS)

*by* Science Writer



Since Pilgrim days corn has been a popular food in American diets. Today dishes using corn meal or corn grits are served at breakfast, lunch, dinner.

As scientific information was gathered about this popular grain, it was found that Nature had been bountiful with certain food essentials and stinting with others. Unfortunately, only small amounts of certain vitamins and other nutrients which are essential to human health were found to be present. Furthermore, unavoidable losses occurred when the grain was degermed. Degerming allows the product to be packaged for nationwide distribution without spoiling.

When corn millers realized this situation, they took an important step to correct it. They used enrichment.[1]

Enrichment is essentially a simple process. It restores important vitamins and minerals to whole grain values. And, in the case of whole corn meal, which is naturally low in niacin and iron, it increases the values for these essentials over whole grain levels.

These are the vitamins used in enriching corn meal and corn grits:

**Thiamine,** also called vitamin $B_1$, which helps to build physical and mental health. It is essential for normal appetite, intestinal activity and sound nerves.

**Riboflavin,** also called vitamin $B_2$. This vitamin is essential for growth. It helps to keep body tissues healthy and to maintain proper function of the eyes.

**Niacin,** another "B" vitamin, is needed for healthy body tissues. Its use in the American diet has done much to make a serious disease called pellagra disappear.

In addition to the "B" vitamins, *iron* is used in all enrichment of corn meal and grits. And, at the miller's option, calcium and vitamin D may be added.

Our Federal government and many state governments have established maximum and minimum enrichment levels which the various forms of corn meal and grits must meet to be acceptable in commerce. For instance, the Federal Standards for enriched corn meal and enriched corn grits are as follows:

| | MIN. | MAX. |
|---|---|---|
| | (Mg. per lb.) | |
| **Thiamine** | **2.0** | **3.0** |
| **Riboflavin** | **1.2** | **1.8** |
| **Niacin** | **16.0** | **24.0** |
| **Iron** | **13.0** | **26.0** |
| ADDITIONAL AT MILLER'S OPTION | | |
| Calcium | 500.0 | 750.0 |
| Vitamin D* | 250.0† | 1,000.0† |

*Although an optional ingredient, not considered necessary in corn enrichment. †U.S.P. units per lb.

The Federal Standards further provide that the levels for enriched grits must not fall below 85% of the minimum figures after a specific rinsing test.

The enriching ingredients are combined into a form called premix which millers add during processing so that enrichment is spread evenly throughout the product.

The vitamins used in enrichment are manufactured. Scientists first learned the chemical composition of vitamins, then isolated the pure substance. Then they "built" a duplicate. This duplicate is identical with Nature's product chemically and in biological activity. A vitamin is a vitamin regardless of its source, just as salt is salt whether it comes from a mine or is evaporated from the sea. So efficient is large scale manufacturing that vitamins are available to millers at a lower cost than if they were extracted from natural sources.

The Hoffmann-La Roche people, pioneers in research and manufacture, make top-quality vitamins literally by the tons. In fact, a large percent of the vitamins used in enrichment of corn meal and grits, family white flour, white bread, macaroni products, and white rice, come from the Roche plant. Using amazingly complex processes with scientific production controls, Roche employs modern, special equipment which fills whole buildings, each one a city block square and many stories high.

This article, reprints of which are available without charge, is published as a service to millers of corn meals and corn grits by the Vitamin Division of Hoffmann-La Roche Inc., Nutley 10, New Jersey. In Canada: Hoffmann-La Roche Ltd., 286 St. Paul Street, West, Montreal, Quebec.

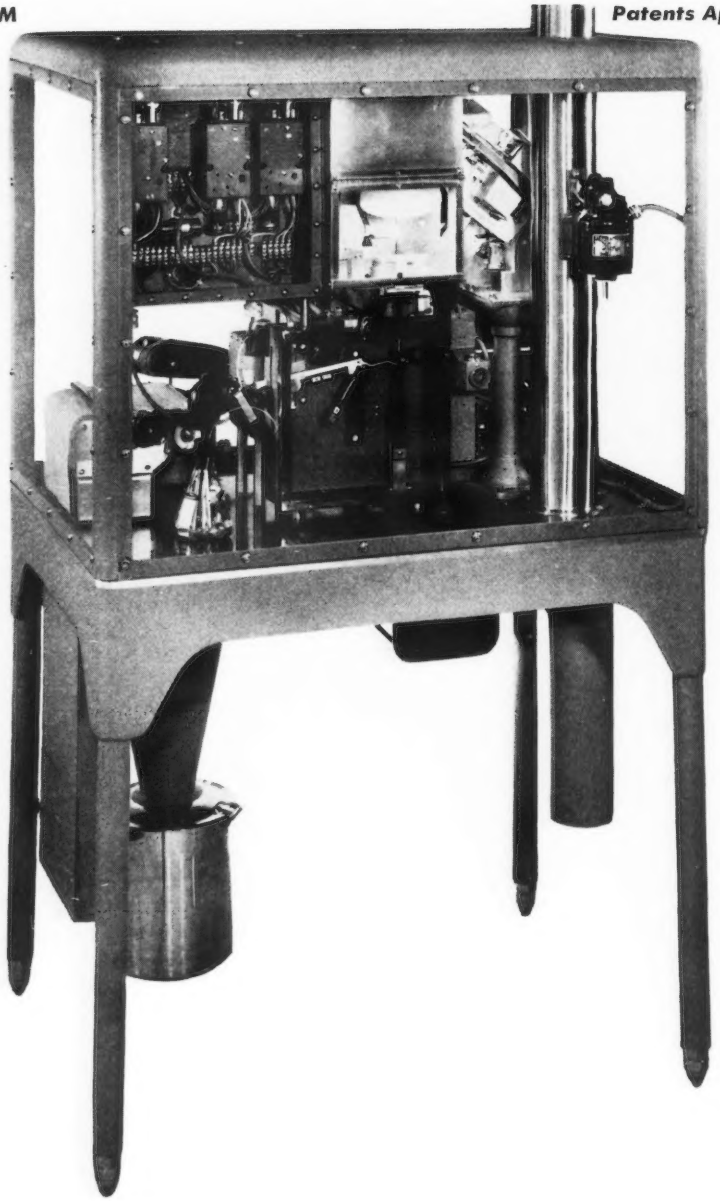
[1]An excellent color film on the enrichment of corn meal and grits has been produced by Clemson Agricultural College, Clemson, S. C. Widely recognized as an outstanding educational film on food and nutrition it is being shown by many health departments and schools.

*Millers of corn meal and corn grits help in the fight against dietary deficiency diseases and in promoting good nutrition when they enrich their products with thiamine, riboflavin, niacin and iron plus calcium.*

# CONTINUOUS FULLY-AUTOMATIC ULTRA-RAPID MOISTURE RECORDER

*Model CM*

*Patents Applied For*



For
Powdery
or
Granular
Materials

---

ONCE
EVERY
12
MINUTES
A Fresh
Sample of
Material
is Taken —
Automatically
— from the
Moving Main
Stream
(or By-Pass of
Main Stream)
And its
Moisture
Content
Recorded

Accurate
to Within
One Tenth of
One Percent
(plus or minus)

---

Moisture
Content
Recorded
Automatically
On Continuous
Strip Chart
and Dated
Automatically

---

Provides
a Record
of Moisture
Contents
24 Hours
Each Day
Seven Days
a Week

*Manufactured in U.S.A. Exclusively by*

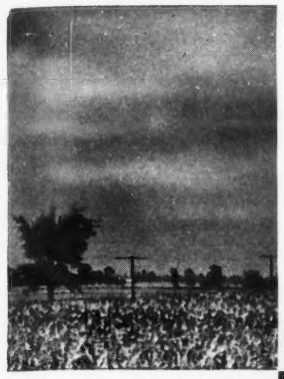
## BRABENDER CORPORATION

Established 1938

Tel: HUbbard 7-0214

ROCHELLE PARK, N. J.

VOLUME 2 • NUMBER 3 • MARCH 1957



# CEREAL SCIENCE *today*

## FEATURES

Commercial Research. K. L. Thomas and W. E. Anklam ..... 47

## TECHNICAL SECTION

Recent French Research on Cereals. Jean Buré ..... 52
Modern Methods of Analysis Applicable to Cereal Problems. J. Hawthorn ..... 57

## DEPARTMENTS

Editorial ..... 45
A.A.C.C. Local Sections ..... 65
People, Products, Patter ..... 66
Sanitation ..... 67
"30" ..... 68

## STAFF

PAUL RAMSTAD, Acting Editor
R. J. TARLETON, Managing Editor

C. H. BAILEY, Consulting Editor
EUNICE R. BROWN, Assistant Editor
HARLEY L. WARD, Advertising Manager
DOREEN CHRISTENSON, Circulation Manager

**DEPARTMENT EDITORS**
**Baking Technology:**
Otto G. Jensen, Oscar Skovholt

**Feed and Feed Formulation:**
S. F. Brockington, Loren V. Burns

**Flour Milling:**
R. K. Durham, H. H. Schopmeyer

**Nutrition:**
W. B. Bradley, Clinton L. Brooke

**Sanitation:**
Ross H. Cory, Kenton L. Harris

**Starch and Starch Products:**
Frank E. Horan, Norman Kennedy

**CORRESPONDING EDITORS**
AUSTRALIA: R. A. Bottomley
CANADA: L. R. Patton, H. Harms
DENMARK: Holger Jorgensen
ENGLAND: J. B. M. Coppock, C. R. Jones
FRANCE: Jean Buré
GERMANY: Paul Pelshenke
HOLLAND: G. L. Bertram
ITALY: Ottavio Chiriotti
JAPAN: Mitsuo Uemura
NORWAY: Halvor Norheim
PERU: Miguel Rafic
SPAIN: A. Quintana Mari
SWEDEN: Sven Hagberg
SWITZERLAND: L. S. Cuendet

COVER: A section of the Minneapolis milling district as viewed through the famous stone arch bridge (Photo courtesy General Mills, Inc.)

Copyright 1957 by the AMERICAN ASSOCIATION OF CEREAL CHEMISTS, INC.

*CEREAL SCIENCE Today* is published ten times per year (monthly except June and August) by the American Association of Cereal Chemists, from 500 South 5th Street, Minneapolis 15, Minnesota. Editorial Headquarters and Circulation Department: University Farm, St. Paul 1, Minn. Advertising Office: 360 N. Michigan Ave., Chicago 1, Ill. Entered as second class matter at the post office at Minneapolis, Minn., under the Act of August 24, 1912.

The American Association of Cereal Chemists assumes no responsibility for the statements and opinions advanced by contributors to its publications. Views expressed in the editorials are those of the editors and do not necessarily represent the official position of the American Association of Cereal Chemists.

Subscription rates: 1 year, $3.00; 2 years, $5.00; 3 years, $7.00. Foreign postage: $1.00 per year extra. Back issues available on request. Single copies: 35 cents.

CHANGE OF ADDRESS: Notify Circulation Department, American Association of Cereal Chemists, University Farm, St. Paul 1, Minn. Include both old and new addresses and postal zone number, if any.

Some of those groceries would be as out of date today as the rumble seat itself! As you know, new processing methods, new packaging, new ingredients have changed many food products.

Even staples like family flour have been improved, thanks to vitamin enrichment. Today, food buyers *expect* food products to carry the "ENRICHED LABEL".

Twenty years ago, just about the time the rumble seat was on its way out, mass production of vitamins was just getting underway. One of the first companies to master the techniques of manufacturing quality vitamins was Chas. Pfizer & Co., Inc.

*Since the middle 1930's Pfizer has continually been a leader in developing new and better forms of vitamins for the food and pharmaceutical industries.* Pfizer BI-CAP® was one of the first enrichment concentrates. And this "head start" in vitamins has continued. It means that Pfizer can help you with the newest developments in enrichment products.

*PFIZER BI-CAP* has recently been improved through vitamin research. It is now a lighter color enrichment mixture with an even dispersion that overcomes unsightly agglomeration. All three forms of BI-CAP are also made with thiamine mononitrate for Better Vitamin $B_1$ stability.

Continued Pfizer research in riboflavin, thiamine and other nutritional additives such as amino acids will help you offer improved flour for tomorrow's improved bread and baked goods. Look to Pfizer for the finest enrichment concentrates.

**CHAS. PFIZER & CO., INC., Chemical Sales Division,** 630 Flushing Ave., Brooklyn 6, N. Y.
Branch Offices: Chicago, Ill.; San Francisco, Calif.; Vernon, Calif.; Atlanta, Ga.; Dallas, Tex.

**PIONEER AND LEADING MANUFACTURER OF VITAMINS**

Pfizer

# Editorial

THE FUNDAMENTAL PROBLEMS of cereal chemists are the same the world over, and other countries than one's own do not introduce many new interests. However, it is illuminating to look back on one's experiences for some forty years.

In the early days, chemistry was less complex and demands on the cereal chemist were less exacting than today. The practicing cereal chemist often was not as fully trained in the fundamentals of chemistry as he should have been. Indeed, there was an impression that the general run of mill chemists, although possessing special knowledge in their own field, were perhaps not of the caliber of chemists in other fields of work. We do not agree, but if there was even the slightest justification for this opinion 40 to 50 years ago, there certainly is not today, for the modern cereal chemist must be a first-class and properly trained chemist, possessing practical experience in almost every branch of the subject. As an analyst he must be competent in nearly all the new and advanced techniques; he must be not only an organic chemist, but also both an inorganic and a physical chemist. He must be experienced in nutrition, competent in microbiological assays, and capable of dealing with most modern methods of making vitamin and amino acid assays.

If we compare the type of work we cereal chemists did in 1920 and earlier with our responsibilities today, we are perhaps amazed at the advances made. Nevertheless, much remains to be done. How little we know of some of the really fundamental practical problems that face the baker today! We still do not possess a simple and sufficiently accurate test to measure dough ripeness in the bakehouse. Yet the nature and quality of bread is largely dependent on the actual degree of maturity attained by the fermenting dough. Does yeast really play a major role in dough ripening, or is it mainly the complex enzymic systems in the flour and other dough ingredients? Perhaps the new and novel ideas in bread manufacture now being used will bring answers to many of these problems.

In any event, reminiscences are pleasant and memories of the great pioneers of the past in our field of work are gratifying. There is today before the rising modern cereal chemist a splendid vista of endeavor and research, the outcome of which will be of great value to mankind.

D. W. KENT-JONES
*London, England*

# A PROGRESS REPORT

## from C. W. Brabender...

### Tomorrow's Testing Today

It's been less than two years since I returned to my old job (and hobby!) of designing and manufacturing rheological flour and dough testing equipment for quality control and research in the cereal industries. From talks, company advertising, and the AACC Farinograph and Amylograph Check Sample Service, many cereal chemists are already familiar with the continued progress which has been made in improving the original design of C. W. Brabender-invented equipment.

More than twenty years ago it was my privilege to introduce such instruments as the farinograph, extensograph, amylograph, semi-automatic rapid moisture tester, etc. The design of these machines was many years ahead of their time. It took more than a decade to win their acceptance in the cereal and baking industry. With the high requirements for flour uniformity, caused by the high degree of mechanization of the baking industry, they have served well as the best means of measuring flour quality in terms of "shop performance".

A machine design — however perfect — is bound to show some need for improvement as applications arise in new fields like cake mixes and specialty and industrial flours. The increasing habit of the large volume flour users, like the bakers, to specify flour in terms of Brabender "language" instead of protein and ash, has brought an increasing demand for higher accuracy and better duplication. Likewise, bakers need increased production of curves per machine and man hour.

We have accomplished much in the last two years in our new South Hackensack, New Jersey, factory.

**The standard farinograph** has been re-designed on the basis of suggestions made by cereal chemists and bakery production men over the last ten years. For example, the dynamometer capacity has been increased two and a half times, thereby stabilizing it against power line fluctuations. Even single phase AC machines are now equipped with this stabilizing feature. Mixer calibration has been improved to a heretofore almost unbelievable degree. Stainless steel mixers have been designed which can be calibrated on the level of the old bronze mixer so that the old farinograms in your files do not become obsolete. High speed and variable speed dynamometers are available for use in high speed wheat testing and research. A twin-swing mixer system is now available and can be attached to the old farinographs. This permits using two mixers at the same time, and thereby increasing the capacity of a single farinograph by 50%.

The many suggestions made by cereal chemists and bakery production men over the years have led us to design an additional, ENTIRELY NEW farinograph, the prototype of which was shown at the 1956 AACC Convention. It allows us to assemble "job-rated" farinographs. The well-known components of the classical standard farinograph can be combined with a wide variety of new components such as multi-speed, high speed, and variable speed dynamometers. Variable sensitivity and suppressed zero point scale heads and multi-speed kymographs have been created. Other features such as constant rate of temperature increase, pressure thermostats have been designed so that it is now possible to produce dough "amylograms" on the farinograph.

Of course, there is nothing basically new with these features. Most all of them have been applied in the past in custom built, expensive research farinographs, which have been very successful in creating new products and helping develop new processes involving flour and dough processing. The conception of the new "job-rated" farinograph makes it possible to assemble machines from standard parts in stock for a reasonable price and with fast delivery. For example, you may order a very basic, inexpensive unit for the purpose of performing a simple job, say, determining proper dough consistency in a test bakery. The simplest, lowest priced, new farinograph assembly will perform in this application. It would be "job-rated" to this application. Later on you may decide that you need a more elaborate machine — either the standard farinograph or a very complicated research farinograph. Parts then will be available to modify your present machine in your own laboratory.

The new farinograph is closely standardized and calibrated so that it will always produce the same results and curves as those you have obtained for many years from your standard farinograph.

**The extensograph** has had many enthusiastic friends over the years because of its tremendous potential. This is indicated by the great number of papers published in CEREAL CHEMISTRY and other journals. It has proven its value in quality control and research, but it has met with some objections because of the operational skill needed to obtain accuracy and duplication. It now has been re-designed. It is today a foolproof machine designed for normal operational skill without sacrificing any of its old features which have built its fame in more than forty countries.

### There Is No Obsolete Machine on the Market

All of the improvements I have mentioned have been accomplished without deviating from the principle of allowing owners of older machines to have their equipment modernized at minimum cost — the principle used so successfully with the Leica camera. No improvement nor attachment is acceptable unless it will fit the oldest machine, thus permitting ease of modernization. Due to the long life span of C. W. Brabender-designed machines — now more than twenty years — this seems to be a "must" on which there should be no compromise.

Thus, all C. W. Brabender-designed dough testing machines, no matter where or when they were made, can be modified in accordance with the above descriptions in our South Hackensack, New Jersey, plant, with full guarantee for performance.

Brabender

**C. W. BRABENDER INSTRUMENTS, Inc.**

**SOUTH HACKENSACK, NEW JERSEY**

*Exclusively franchised Sales and Service Agents for the Milling Industry.*

**MIAG NORTHAMERICA, Inc.**

**1616 South 8th Street**
**Minneapolis 4, Minnesota**
**Telephone: FEderal 9-5713**

A PARTNER OF FOOD SCIENCE

# Commercial Research

**By K. L. Thomas and W. E. Anklam***

A PAIR OF LIVELY spooks traditionally haunts industrial research laboratories. They are the twin specters of a product without a market . . . and a market without a product.

Far more than a tricky exercise with words, these two unpleasant nightmares neatly point up the tight relationship which must exist today between product (scientific) research and commercial (or marketing) research. It is a lesson which is constantly — and painfully — being learned and re-learned.

New products are one obvious goal which a company has in mind when it sets up a research organization, however large or small. But new products which fail to find a market are a futile waste of technical talent and hard-earned dollars.

On the other hand, supporting a marketing research group without being able to develop products for the markets it uncovers is a lot like going fishing without rod, reel, or fish hooks.

Obviously the product-without-a-market or market-without-a-product dilemma can only be solved by a close partnership between marketing research and technical research. And it's equally clear that there is little point in any lengthy debate on who leads which . . . the object of the game is for both groups to end in a dead heat with the right product for the right market at the right time.

To put it another way, the simple and shining goal of industrial research is to develop products or services which can be sold at a profit.

But look at that statement again: "Develop products or services which can be sold at a profit." Within those eleven words are most of the headaches and heartaches which pester corporation officials and their research directors . . . in fact, the entire research organization. Let's break the sentence apart and see why:

"*Develop* . . ." (basic research, applied research, pilot plant work, design of production lines and machinery)

". . . *products or services* . . ." (market studies, consumer preferences, economic trends)

". . . *which can be sold* . . ." (consumer testing, existing competition, market trends, advertising and merchandising, channels of distribution)

". . . *at a profit.*" (cost, prices, margins, possible competitive strategy, demand for the product).

While the basic pattern is pretty much the same from industry to industry and company to company, just how it all fits together within one company might illuminate the day-to-day solving of these problems and show the technical research and marketing research partnership at work. So let's look at the food research side of General Mills' many research activities.

New food products are constantly under study in our research laboratories. But *developing* food *products which can be sold at a profit* is much more than a test-tube-and-beaker operation.

In General Mills consumer food development, constant cooperation exists between Food Development, Food Engineering, Physics, and Packaging Research, and our Consumer Products Commercial Research Department. And it is this latter group which has the problem of incorporating marketing data into the thinking of the various technical groups to guide them in the development of products which will succeed.

The authors are members of the Commercial and Economic Research Activity at General Mills Research Laboratories. K. L. Thomas (left) is section leader, Food Research, W. E. Anklam (right), Activity Director.

*General Mills, Inc., Minneapolis. This article is reprinted with permission from Vol. 10, No. 3 of *Progress Thru Research*, a publication of the GM Research Laboratories.

### Market Size and Structure

Statistics show that the per capita consumption of food is remarkably constant. And considering that some two million new food consumers are being added to our population annually, it becomes evident that the total market for food in the United States is ever growing — a market already so vast that in the aggregate it almost defies comprehension. However, the fact that some 166 million people in this country get hungry three times a day does not assure the success of any given food product.

A potential market exists only when related to a specific product. When you consider that the modern homemaker has a choice of somewhere between eight and ten thousand different items and sizes in the modern supermarket, it becomes obvious that the amount of time she can spend looking for your particular product is severely limited.

The "profile," so to speak, of the food market is constantly and drastically changing. The sale of cake mixes and instant coffee, for example, has skyrocketed in the past few years. On the other hand, products in great demand a few years ago might be nonexistent now. For the food manufacturer this ever-shifting pattern holds great opportunity . . . and severe pitfalls! One of the duties of commercial research is to determine just where the opportunities, and the pitfalls, exist and then apply the knowledge in guiding technical research in new product development.

Happily, there are a good many ways to trace the changing consumption of broad classifications of food products over long periods of time. Naturally, if the consumption of one classification is on the increase, the development of a product within that classification is encouraged, at least from this one standpoint. But the mere fact that the trend in any particular product classification has been steadily downward does not eliminate it from consideration. (The man's vest had at one time become nearly extinct. But with brass buttons, bright colors, and a new name — weskit — the vest made a profitable comeback.) A sliding market isn't necessarily a dead one. Intensive study of available products, how they can be improved, how they can be sold at a lower price, or how they can be more convenient for the consumer to use can uncover new opportunities. It is up to commercial research to find these opportunities. And once technical research knows *what* is needed, it can direct its efforts to finding solutions.

### Product "Road Maps"

One approach in finding areas where such improvements can be made is to set down in an orderly manner a study of the food the homemaker is currently serving the family. With this as a base, it is possible to examine each individual component of the meal in terms of how the preparation can be made more convenient, how the end product can be made more attractive, whether there is a possibility of reducing the cost, or if there are new flavor combinations which might possibly be explored.

Of equal importance is the recognition of what the homemaker is currently *not* serving. If the study points to groups of foods which have for some reason fallen into disrepute, it may be possible to find the reasons why. Ways can sometimes be found to overcome factors causing a decline, opening up new product possibilities.

These preliminary market studies therefore are carried on to find and point to the areas that appear ripe for exploitation, thus providing technical research with "road maps" before it embarks on new development programs. Clearly, preliminary market studies are not carried on with the thought of putting a damper on creative technical research. The studies should serve especially to seek out existing product deficiencies and to alert technical research to the possibility of building in needed product attributes.

It might be pointed out, however, that the results of these market studies are constantly subject to modification and adjustment as the development work proceeds; the scientist doing the development work is always a ripe source of product ideas based on extensive technical backgrounds.

### Product "Proving Grounds"

In addition, the need for an alteration in the product might become evident in panel testing—that part of the commercial research activity where selected employees of the Research Laboratories are called in to give the product an initial screening so that their reactions can serve as a guide in further development.

After the product has been graduated from panel testing, commercial research people take it directly to consumers — housewives — for further evaluation. At this stage it may be altered a number of times, according to the reaction of the consumers.

This initial consumer screening serves both to guide development work and bring into focus more sharply the problem of obtaining a feeling of the market through the study of consumer reaction and acceptance. The panel and consumer tests are the initial "proving grounds" for a new product.

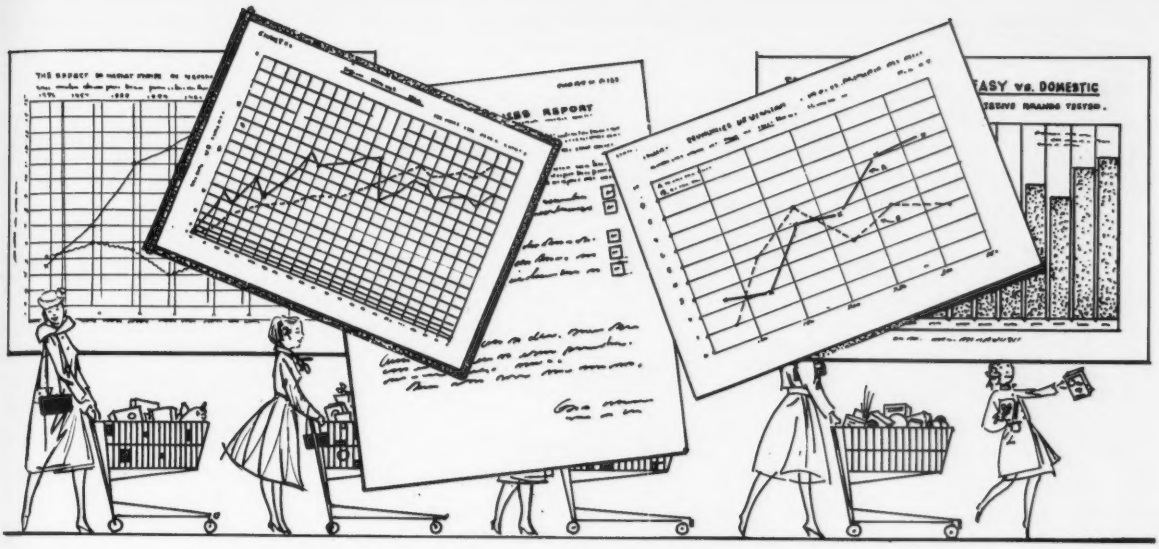
The value of these tests is illustrated by the way consumers frequently are indifferent to, or completely disregard, those features which research people think are outstanding and which are readily demonstrated in the laboratory. This causes no small degree of discouragement among both commercial and technical research people, who tend to feel that the consumer may not be acting rationally. However, rational or not, her reaction to a product during the tests reflects the same reaction she, and millions of other housewives like her, will have when they do their grocery shopping.

Why consumers buy or don't buy, like or dislike, is difficult to measure, or even define. However, techniques are now being developed, particularly in the social sciences, which may help determine what motivates the consumer. But at the present time there appears to be no substitute for good judgment backed by exacting research.

It must be emphasized that market data and the results of consumer testing programs are open to interpretation. If these data are approached constructively by both technical and commercial research people, roadblocks can be defined and circumvented in the development work.

### Competition

While the groundwork is being laid in the laboratory for a new product, commercial research is faced with the task of defining the competition the product will have from similar, or related products. Also, it must evaluate the marketing strategy the other manufacturers might employ in



the event of a new competitor. (A gasoline company decides to give away a gift with the purchase of every five gallons. A competing gas company then lowers its prices enough to at least hold its regular customers, and possibly enough to absorb customers from the first company. Can the new product stand such changes in competition?)

Surveys are first made of products designed to fill a certain need. These can directly influence the direction of technical development. An analysis of these products sometimes reveals the possibilities of new, unique ways to fill the market need. Thus, the improvement can be built into a new product, lifting it "above" competition. (Gas lamps once filled the need for lights on automobiles. But electric lights completely took over the market, for obvious reasons.)

This, certainly, is a highly optimistic explanation, but it should reveal the importance of analyzing existing products. On the other hand, such an analysis of these products might show that it would be too difficult to compete profitably, in which case the development plan would be dropped without further expense.

Like the profile of consumer buying, the competitive picture is constantly changing—new products are going on the market, others are being taken off, and prices are changing for many different reasons. It therefore becomes necessary for commercial research people to keep a close, analytical eye on the entire picture throughout the development of a product, and indeed, even after it is on the market, in case it could be altered to meet a "new" competition more successfully.

An interesting way in which a new product can change the competitive picture is illustrated in the marketing of General Mills' Betty Crocker Date Bar Mix. At first glance, it could appear that this item might infringe on the cake mix market. However, the Date Bar Mix was different enough so that it did nothing to the cake mix market, but resulted in the over-all expansion of the cookie mix market and an increase in the over-all consumption of mixes. And since the per capita consumption of food is amazingly static, it can be assumed that the Date Bars resulted in a decrease in consumption of other foods. Here was a product which induced the shifting of consumer preference—a difficult but profitable accomplishment which is an always-present research goal. The latent possibility of a consumer preference shift may always be there, but developing the product to precipitate the shift is difficult. Thorough study of the competitive picture at least provides broad outlines to follow in accomplishing this goal.

### Cost, Prices, and Margins

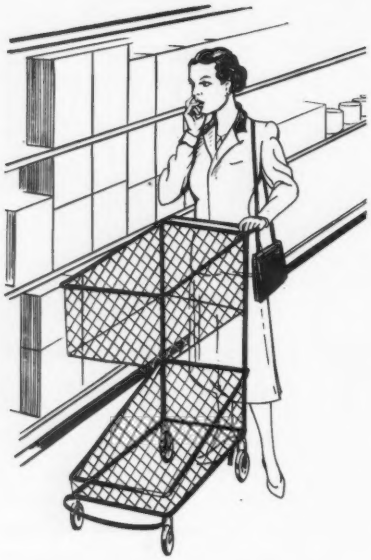
The food scientist, working constantly to develop new food items, would be in Utopia if he could have unlimited use of any ingredient without regard to cost. But the evident reality is that he does not. Even when it appears that a certain ingredient could be purchased economically for a new General Mills product, it might not be so. That is, the price of the ingredient might be satisfactory, but if the total marketed quantity is too small, "heavy" buying by one large company might drive the price up, which in turn would force the product price up, which would finally prevent Mrs. Consumer from buying it.

Granted, the increasing cost of the ingredient would tend to lower the demand for it, or cause an increase in production if time were allowed for the cycle to complete itself. But it becomes an expensive matter to let equipment and plant space remain idle while waiting for a price to drop on one ingredient. Too often the supply of an ingredient cannot be increased readily, if at all, to offset the jump in price. The consumer, too, has a right to expect a continuing supply of a product once it is put on the market.

Commercial research must determine if a certain ingredient can or cannot be purchased indefinitely at a certain quality, quantity, and price to ensure continuous product quality at a price which the consumer is willing to pay. And this must be determined to a large extent before a lot of time and effort are spent developing a new product.

The American homemaker is free to pick and choose, and more than one warehouse is stocked with food products which cannot be sold either because price became prohibitive or the product quality did not assure repeat purchase.

There also arises the occasion when technical research is able to de-



fine the function which an ingredient should perform, engineering has a good idea that it is possible to produce such an ingredient in the necessary quantities, but the ingredient simply does not exist in the form needed. Technical and commercial research must then arrive at a means, usually with the cooperation of the ingredient supplier, to obtain the needed form.

Net profits from a new product are also the joint concern of both commercial and technical research. Unless certain profit goals are set up, and met, the introduction of a new product might easily result in a dilution of over-all profits.

The introduction of any new food product is at best a risky business and the question is whether the anticipated return is a reasonable business risk. Product classifications tend over the long run to set certain patterns of return. Creative technical research is capable of breaking through these patterns through more fully satisfying consumer wants. In arriving at the final decision to enter the market with something new, certainly both technical and commercial considerations are involved.

#### Advertising and Merchandising

The advertising and merchandising considerations in new product development are of constant concern to both technical and commercial research.

The importance of advertising and merchandising has become tremendous with the advent of the supermarket, since in this type of food distribution there is no personal salesmanship at the point of purchase; whether the consumer does or does not take the product from the shelf depends entirely upon her own thinking.

Therefore, commercial research must determine what attributes need to be built into a product that will appeal to the consumer — and these attributes must "sell" the product strictly through advertising and as the product appears on the shelf. Of course, after the initial purchase, product *quality* is absolutely essential to repeat purchases.

Determining simply that a need exists is one thing, but finding the means to fill that need is something different, and usually much tougher. Obviously, the guidance of technical research is essential in screening out ideas that cannot be developed in the laboratory from those that can.

Such product needs are not as easily recognized as might be expected, for there is certainly no lack of products to fill the approximately ¾ ton of food an individual consumes every 365 days. The homemaker may not even recognize the need herself until it is pointed out or created through the promotion and advertising of the product.

The reasons why advertising and merchandising considerations must enter into product development are many. For instance, a particular item might have all the earmarks of great success, but it might be too new and different to gain acceptance readily. It might be ascertained that a certain amount of effort in advertising and merchandising might overcome this, but that the effort might cost so much and take so much time that it would be prohibitive. For example, an automobile manufacturer might eventually "educate" the public to buy only three-wheeled automobiles, but it could take years, and millions of dollars, to do it.

It must be kept in mind what sort of product attributes lend themselves successfully to advertising and merchandising campaigns. Special product features displayed in advertising must also be viewed with an eye toward their possible exclusiveness. A product feature which can easily be duplicated soon loses its competitive value. A creative approach by both technical and commercial research can result in advantages which are difficult for competitors to overcome, and which provide firm bases for building advertising and merchandising campaigns.

Integrating the information from the two sources is truly a process which involves the best efforts of all individuals concerned regardless of their particular contribution to the program. How can this be done?

1. It first of all requires an atmosphere which is conducive to the best research efforts of the entire group. Creative research is something that cannot be forced. It must come from within. The price of progress is problems, and if superior products are to be the result of the combined effort, each individual must know that his share is ultimately contributing to the end result. It is a case of approaching the development process with the attitude of, "What can I contribute? Not, what can I gain?"

2. It requires the mutual understanding of both technical and commercial research, of what each can ultimately contribute.

#### Summary

Only a few of the many considerations which are of concern to both technical and commercial research have been discussed. They should, however, illustrate the interrelationships so vitally important in new product development.

In a nutshell, commercial research should reflect and anticipate:

1. The needs and possible changes in habits of consumers.
2. Changing market conditions.
3. Developments of competitors.
4. Marketing and profit needs of the company.

But all of the information developed by commercial research is useless until translated into product development by scientists working in the laboratories. Otherwise it exists in a vacuum. It is only through a partnership with technical research that these efforts have meaning.

A corner of one of the famous Procter & Gamble laboratories at Ivorydale, Ohio.
At P & G, product improvement goes hand in hand with the developments of science.

**CONTINUOUS RESEARCH ASSURES TOP QUALITY IN EVERY PROCTER & GAMBLE SHORTENING . . .**

Primex • Sweetex • Pertex
Selex • Primex B & C • Puritan Oil

☆

Procter & Gamble
Cincinnati 1, Ohio

**OVER FIFTY YEARS OF RESEARCH IN FATS AND OILS**

# RECENT FRENCH RESEARCH ON CEREALS[1]

JEAN BURE,[2] French School for Milling, Paris, France, and A. GUILBOT,[3] National Institute for Agronomic Research, Paris France

FOR THE LAST ten years most of the research concerning the cereal industries in France has been coordinated by an organization of the National Center for Scientific Research.

The National Center of Coordination of Studies and Research on Nutrition and Food, or C.N.E.R.N.A., was started in 1946 by Professor E. F. Terroine. It coordinates the research activities of State, as well as professional or private, laboratories concerned with fundamental and applied researches on foods.

From 1945 to 1952 the activity of the laboratories of the cereal industries was directed by the Baking Commission, to which Dr. R. Guillemet had devoted his full activity until his death. The most adequate tribute to his memory was the continuation of his work in accordance with new commissions created in 1952.

Recently, on the occasion of the Jubilee of the Cereals Research Association, Detmold, Germany, one of the authors enumerated the most important achievements of these Commissions (14) and these will be outlined again in this paper.

### Improvement of Wheats

For the last few years the studies carried out in France to improve wheat production, both from the standpoint of quantity and quality, have been concentrated on the following points:

*Characterization of Existing Varieties.* The studies undertaken in 1950 at the Stations of Genetics and Plant Breeding on 120 varieties qualifying for commercial production showed that many of these varieties were not sufficiently resistant to plant diseases, and yielded grain which was too low in protein content (30). These experiments provided information on the locations to which the different varieties were best adapted from the standpoints of yield and baking quality. Information was obtained on the relative baking qualities of the various varieties in a given locality by means of the Chopin Alveograph. The W number[4] should not be considered as an absolute value, but it does allow a general classification of wheats according to baking quality.

As a result of these studies, certain steps were taken in 1945 to increase the average value of W without decreasing the yield.

It is expected that, owing to the new types of farm contracts and the creation of special premiums for high-quality wheats, the farmers will be encouraged to produce wheat of an average W number of 80 or above. This will undoubtedly eliminate all varieties of an inferior W value. However, the problem is complex and it does not seem particularly important to encourage the systematic production of wheats of very high W numbers; in fact, these wheats do not really suit the needs of the French baker and biscuit manufacturers. On the other hand, production of wheats of an average and uniform W value of about 120 is preferable for French industries and even for export purposes. They offer an indisputable, though sometimes ill-recognized, technical value.

*Effect of Climate and Cultural Practices on Production.* It was shown that seeding rates between 80 and 300 kilos per hectare (0.92 to 3.45 U.S. bushels per acre) have no significant influence on the yield and the "baking strength" of the wheat.

The studies of Coïc (18, 19, 20) illustrate the importance of the time at which nitrogen fertilization should be applied. Wheat has important, though moderate, nitrogen needs during its early growth (production of first leaves

The French School of Milling, located in Paris.

[1] Manuscript received July 12, 1956. Presented at the 41st annual meeting, New York, May, 1956.

[2] Professor.

[3] Master of Research.

[4] Among the many devices employed to evaluate dough properties of wheat flour, the alveograph is the instrument of choice in France. Over one thousand French mills use this apparatus to control their flour quality.

A mixer forms the dough automatically under rigorously controlled conditions and at a constant absorption. After a definite relaxation time, the dough is deformed in the shape of a balloon and one records the variation in the pressure inside the balloon as a function of its volume.

The curve obtained is called the Chopin Alveogram. It provides a measure of the elastic and plastic properties of dough at any given moment. The principal characteristic of the curve is the figure "W" which, expressed in thousands of ergs, corresponds to the work of deformation of one gram of dough.

The wheats grown in France almost always contain sufficient amylase activity; hence the strength of a flour is synonymous with its gluten characteristics. The baking value of French flours and wheats can, therefore, be measured for practical as well as legal purposes simply by the Chopin "W" value.

A view of one of the many laboratories in the French School of Milling.

and suckers). This explains why nitrogenous fertilizers are usually added either before sowing or as a covering at the end of winter. But wheat has still further needs for nitrogen at blossoming time, not so much to help development of the stalks as to promote good photosynthetic activity. Therefore, the usual method of fertilizing at the end of winter may be responsible for a later imbalance in nitrogen assimilation when the soil is no longer able to supply enough nitrogen to support the vegetation. This is why the addition of available nitrogen at flowering time helps, especially with poor soils, to increase the yield by increasing the number of kernels per ear and to obtain larger kernels of greater density. Moreover, the nitrogen of the kernels is slightly increased and the W and G figures of the Chopin Alveogram increase substantially. Thus, within the limits of the specific characteristics of each variety, this method of fertilizing favors regularly higher yields and better quality.

The influence of climatic factors is equally important and Geslin (23, 24) has shown the action of temperature on initiation of the reproductive period, a factor influencing the yield. There is an optimum temperature favorable to the growth of the stalks which varies according to wheat type (winter, alternate, or spring). Moreover, the effect of temperature is cumulative: a delayed action of temperature is observed preceding the first growth.

The studies of Longchamp and Gautheret (32) on the physiological effect of weed-destroying hormones, such as 2, 4-D, have made it possible to specify their use. The oily ester solutions cannot be used and sodium salts must be employed at certain doses, according to the varieties of wheat; some varieties are more or less sensitive to these substances, depending on their stage of growth.

In 1948 the Biochemical and Physico-Chemical Laboratory for Cereals summarized their research achievements to date on the evolution of the main components of wheat. Since then the research has been extended to other plant constituents; in particular a thorough study of the B group of vitamins has been undertaken (38). The presence of thiamine and riboflavin in the plant at the beginning of the reproductive phase indicates a hormonal action of these substances. The content of the whole plant in thiamine, riboflavin, and niacin increases afterwards and finally tends to stabilize during the ripening of the grain, as Geddes and Levine (22) have shown for thiamine; the migration takes place towards the grain.

Riboflavin decreases when the protective chlorophyll screen disappears, which seems to point to photodestruction. Similar observations were made by Hoffer, Levine, and Geddes (29).

These vitamins have a specific evolution, but all are concerned with different phases of the development of the plant and of the grain: growth, fertilization, formation of the protein matrix, and beginning of the rapid desiccation of the grain.

Another point which is being studied at present is the development of the total alpha-amylase activity of the grain. Some of the findings of Sandstedt and Beckord (40) were confirmed. Light is one of the factors responsible for the destruction of alpha-amylase activity at the time of chlorophyll disappearance during ripening. Climatic conditions have thus a direct bearing on the alpha-amylase activity of the grain (26).

*Milling Value.* The cereal trade pays tribute to old traditions, and in France as in most countries, WHEAT is a political problem. The official standards of wheat fail to reflect their true flour-yielding potential.

In 1954 we severely criticized the determination of weight per hectoliter; this figure is no longer of practical interest (12), but has had a troublesome influence since 1939, as the extraction rates of flours have been officially based on this specific weight. Much less importance is given nowadays to heavy wheat from the standpoint of rate of extraction. Moreover, moisture regulations make it possible to penalize wheats containing over 17% moisture, and to raise the price of wheats containing less than 13% moisture.

We are at present trying to establish fairer and more equitable standards of cleanliness for grain. In the first place, all the presently admitted tolerances which discourage farmers from delivering clean wheat should be suppressed. Also, determination of the specific weight should[5] be supplanted by other tests which are as easy to perform, but of greater value (weight of 1000 dry kernels, density, etc.). This has led to the designing, in 1950, of the air-displacement densimeter of the French School for Milling.

*Grain Preservation.* French wheat is usually harvested under good conditions and a wet crop does not occur more than once every 4 or 5 years. The problem of grain preservation was more acute during the first few years after 1945, when the number of combines was inadequate, and combining began too early in the morning. Dryers are difficult to amortize and France has been slow in acquir-

[5] In the U.S.A. and Canada, the bushel weight may be informative, since, in a given district, the wheat varieties, climate, fertilizers, and moisture content of the grain are fairly constant; while in Europe, the only significant figures are those representing variations in yearly averages of specific weight.

ing appropriate equipment. Both the fast and the slow types of dryers are required, according to whether the moisture content of the grain is under or over 20%.

Our contribution to the drying problem consisted in studying the drying of grain by air ventilation[6] and the transport of water inside the grain during humidification and desiccation at various temperatures. (10, 11, 15). Such studies may help in finding further possibilities for grain processing and drying.

### Breadmaking Value of French Wheats

*Physico-Chemical Properties of Gluten.* Despite the great amount of research on gluten, including a recent contribution of Bourdet (5, 6), we are still far from having sufficient data as to the real causes of differences in the physical properties of gluten.

Soluble proteins are commonly used in industrial preparations because of their binding and frothing properties. On the basis of this knowledge, Guastalla (25) demonstrated that aqueous solutions of the gluten of a Manitoba type of wheat are more frothy than those of the gluten of local wheat, because more "gliadine" is dissolved.

Similar results were obtained when natural gluten was compared with gluten treated by hydrogen peroxide, provided that the treatment was performed with levels of oxidation which may be considered as "improvers" in breadmaking.

This work demonstrates that there is great probability of a relationship between the breadmaking qualities of flour and the solubility of its proteins. Moreover, it seems that phytin makes the proteins less soluble, and the concurrent action of phytase on phytin, which contributes to the same effect, must also be taken into consideration.

### Comparative Action of Malting and of Roasting on the Composition of Barley

The microscopic and organoleptic characteristics of roasted barley are supposed to be sufficient criteria to determine whether malting is properly carried out in the course of the manufacture of coffee substitutes.

Inadequate malting may be carried out by fraudulent means which are not very easy to detect because of the difficulty in distinguishing between the fraud and undermalting, which is deliberate with some manufacturers. The classical methods, determination of the carbohydrates and amylase activity, are inconclusive. Chromatograms of carbohydrates show no difference when the barleys have been roasted. As to the maltol (2-methyl-3-oxypyrone), the differences are not significant enough in the slightly malted products. We have made fractional separation of proteins (total nitrogen, salt-soluble nitrogen, hordein, glutelin, residual nitrogen), determined soluble and dialyzable nitrogen, and followed the appearance of phospho-aminolipids in barleys and malts (16).

[6] For the time being, we think that the most practical desiccant is a colloidal calcium chloride dispersed over charcoal, treated in an electric oven to expel the gas (Carbagel). At present a French mechanical engineer uses quicklime for drying. The product (hydrated lime) is used for soil reclamation.

The influence of malting can be shown even in roasted barleys by performing the above series of tests on the same sample.

### Studies on Flours

*Reaction of Flours with Phenolic Substances.* The possibility of error in the valuation of flour purity by the Pekar test has been investigated. Friedberg (21) has shown that French wheat varieties differ in their reaction with phenolic acid. These differences, together with the shape of the Chopin Alveogram, offer one of the few means for an immediate evaluation of the wheat varieties of our country. Batches of wheat may differ greatly in their reaction to phenolic acid. Flours obtained at the same extraction rate show great differences of coloring using the Pekar test with pyrocatechol.

*Influence of Smut.* Smutty wheats are subject to official discrimination and are empirically determined by the smell of the various parcels.

The percentages of the grains infected with smut corresponding to different deterioration levels may be determined by microscopic examination.[7]

When it is necessary to mill grain contaminated with more than 0.2% of smut, it is useful to know how the spores are distributed during the milling process. Thus, the flour from the first break rolls where the maximum numbers of spores are collected can be eliminated.

Investigation of the toxicological problems caused by rye rot and wheat dwarf rot (42) were started in 1952.

*Detection of Triticum vulgare in Triticum durum.* In 1954 the French resumed an earlier law[8] which required that all macaroni, noodles, and alimentary pastes be manufactured exclusively from durum wheat products.

Matweef (34) suggested a "tentative method" for identifying products made from *Triticum vulgare*, based on the precipitation, under certain experimental conditions, of sitosterol palmitate when the semolina, macaroni, or noodles, etc., contain *Triticum vulgare* wheat products. The sterol esters may be separated by chromatography on alumina. Italian workers are enthusiastic about this method, but care should be taken before drawing definite conclusions, because even durum wheats contain sterol esters.

Studies have also been made on the identification of ergot, blight, and rye grass by chromatographic separation of their pigments (41).

*Flour Preservation.* Economic conditions in France usually require the delivery of flour in jute bags. Moreover, to enable the Laboratories for the Repression of Fraud to identify dealers' names even at the customer's plant, bulk deliveries are not permitted. The difficulty of finding workmen to empty the bags in the bakeries of the

[7] It has been customary in France to make empirical and vague classifications of wheat contaminated with smut on the basis of the intensity of the odor. The extent of contamination may be determined objectively by mechanically shaking 100 g. of the ground wheat with 200 ml. of water in a 500-ml. Erlenmeyer flask for 5 min. and counting the spores in 1.0 microliter of the suspension with a hematimeter under a microscope. It has been found that large, medium, and small smut balls contain an average of 19, 12, and 9 million spores, respectively. Using 12 million spores as an average value, the actual smut spore counts can be translated into the percentage of smut contamination.

[8] Law of July 3, 1934, completed by Law No. 54,379 of April 5, 1954.

# PRELIMINARY PROGRAM

# 42nd

# ANNUAL MEETING

☆ ☆ ☆

## AMERICAN ASSOCIATION OF CEREAL CHEMISTS

*May 19-23, 1957*

## SHERATON-PALACE HOTEL SAN FRANCISCO, CALIF.

## GENERAL PROGRAM

**Sunday, May 19**
Registration
2:00 p.m.
Board of Directors Meeting
2:00 p.m.
President's Reception and Buffet
6:00 p.m. Gold Room
8:00 p.m. Colored Slides of Finland and neighboring countries by E. F. Seeborg

**Monday, May 20**
Registration
8:00 a.m.
Exhibits
8:00 a.m. Official Opening — Concert Room
Opening Session
10:00 a.m. Rose Room
Wallace and Tiernan Luncheon
Noon Gold Room
Technical Session
2:00 p.m. Rose Room

**Tuesday, May 21**
Registration
8:00 a.m.
Technical Session
9:00 a.m. Rose Room
Annual Business Meeting
11:00 a.m. Rose Room
General Committee Instructions
1:30 p.m.
Technical Committee Meetings (Open)
2:15 p.m.
Pacific Northwest Annual Meeting
7:30 p.m.

**Wednesday, May 22**
Registration
8:00 a.m.
Technical Session
9:00 a.m. Rose Room
National and Section Officers Luncheon
Noon
Technical Session
2:00 p.m. Rose Room
Annual Banquet and Dance (Informal)
6:30 p.m. Gold Room
Osborne Medal Award Presentation

**Thursday, May 23**
Registration
8:00 a.m.
Technical Session
9:30 a.m. Rose Room
Board of Directors Meeting
Noon
Technical Session
2:00 p.m. Rose Room
Adjournment

### Program Items of Special Interest

Osborne Medal Award Address
THE MEDALIST

Report on the International Association for Cereal Chemistry
DR. J. A. ANDERSON, Chief Chemist, Grain Research Laboratory, Board of Grain Commissioners for Canada, Vice-president of the International Association for Cereal Chemistry

**Guest Speakers**

DYNAMIC SHIFTS IN THE AMERICAN CEREAL ECONOMY
DR. KARL BRANDT, Associate Director
Food Research Institute
Stanford University
Stanford, California

ESSENTIAL FATTY ACIDS, LIPID METABOLISM, AND VASCULAR DISEASE
DR. LAURENCE KINSELL, Director
Institute of Metabolic Research
Highland Alameda County Hospital
Oakland, California

THE FIGHT FOR PURE FOODS
MR. CHARLES W. CRAWFORD
(Formerly in charge,
Food and Drug Administration)
Mill Valley, California

THE OREGON WHEAT COMMISSION — ITS AIMS AND ACCOMPLISHMENTS
MR. ROBERT B. TAYLOR, Administrator
Oregon Wheat Commission
Pendleton, Oregon

**Technical Committee Reports and Meetings**

TECHNICAL COMMITTEE WORK OF THE ASSOCIATION
Dr. John A. Johnson, Chairman,
Technical Policy Committee

The following Technical Committees will be in open session:
Bran-in-Flour
Cake Flour
Canadian Wheat Milling Procedure
Cookie Flour
Cracker Flour
Farinograph Standardization
Feed and Feedstuffs Evaluation
Hard Winter Wheat Milling Procedure
National Check Sample
Sanitation Methods
Sedimentation Test for Wheat and Flour Quality
Soft Wheat Experimental Milling Procedure
Soybean Products
Test Baking
Vitamins and Minerals in Enriched Cereal Products

## LADIES' PROGRAM

**Sunday, May 19**
2:00 p.m. Hospitality Room Opens in Parlor A
6:00 p.m. President's Reception and Buffet (Informal)
8:00 p.m. Colored slides of Finland and neighboring countries by E. F. Seeborg

**Monday, May 20**
9:00 a.m. Hospitality Room — Parlor A
Continental Breakfast, courtesy of Northern California Section
2:00 p.m. Tour of San Francisco

**Tuesday, May 21**

| | |
|---|---|
| 9:00 a.m. | Hospitality Room — Parlor A<br>Continental Breakfast |
| 1:00 p.m. | Luncheon in the Peacock Court of the Mark Hopkins Hotel (Courtesy of Wallace and Tiernan). This is an opportunity to view San Francisco from Top O' The Mark |
| 2:30 p.m. | Flower arrangement demonstration by the famous florist, Podesta and Baldocchi |

**Wednesday, May 22**

| | |
|---|---|
| 9:00 a.m. | Hospitality Room — Parlor A<br>Continental Breakfast |
| 10:00 a.m. | Trip to Rod McClellan's "Acres (63) of Orchids" |
| Noon | Luncheon at Fisherman's Wharf |
| 6:30 p.m. | Annual Banquet and Dance — Gold Room |

**Thursday, May 23**

| | |
|---|---|
| 9:00 a.m. | Hospitality Room — Parlor A |
| 10:00 a.m. | Trip over Golden Gate Bridge, Visit to Muir Woods (Giant California Redwoods) |
| Noon | Luncheon at Alta Mira at Sausalito (Overlooking San Francisco Bay) |

## TECHNICAL PROGRAM PAPERS

### Production and Storage of Cereals

Breeding for Quality
L. P. REITZ, Field Crops Research Branch, U.S.D.A., Beltsville, Md.

Progress in Breeding Bread Wheats for Quality in North America
A. M. SCHLEHUBER, Oklahoma A. & M. College, Stillwater, Okla.

Pigments of Wheat Plants as Related to Hessian Fly Resistance and Infestation
ROBERT M. GROSSMAN, BYRON S. MILLER, JOHN A. JOHNSON, and ELMER T. JONES, Kansas State College, Manhattan, Kan.

Wheat Storage Under Nitrogen
R. L. GLASS, H. V. HINTZ, and W. F. GEDDES, University of Minnesota, St. Paul, Minn.

Insect Infestation of Grain and Cereal Product Contamination
KENTON L. HARRIS, Food and Drug Administration, Washington, D.C.

Changes in Rough Rice at Different Moisture Contents During Storage at Controlled Temperatures
D. F. HOUSTON, R. P. STRAKA, I. R. HUNTER, R. L. ROBERTS, and E. B. KESTER, Western Utilization Research Branch, U.S.D.A., Albany, Calif.

The Chitin Content of Wheat as an Index of Mold Contamination
MOISHE GOLUBCHUK, L. S. CUENDET, and W. F. GEDDES, University of Minnesota, St. Paul, Minn.

### Wheat Milling

Conditioning of North American Wheats
HEINZ GEHLE and HEINZ CLEVE, Miag Corporation, Braunschweig, Germany

Recent Advances in British Milling Technology
D. G. ELIAS and R. A. SCOTT, Henry Simon, Ltd., Stockport, England

Opportunities Unlimited for the Cereal Chemist and the Operative Miller
A. A. ACKELS, General Mills, Inc., San Francisco, Calif.

Recent Developments in Experimental Milling Procedures
C. R. HARLOW, Pillsbury Mills, Inc., Enid, Okla.

### Flour Quality Characteristics and Testing

Effect of Mixing on Physical Properties of Dough
C. J. DEMPSTER and I. HLYNKA, Grain Research Laboratory, Board of Grain Commissioners for Canada, Winnipeg, Manitoba

Quality Characteristics of Western Wheat Varieties
M. A. BARMORE, Western Wheat Quality Laboratory, U.S.D.A., Pullman, Wash.

Straight vs. 100% Sponge Doughs for Experimental Baking
R. M. SANDSTEDT and PAUL MATTERN, University of Nebraska, Lincoln, Neb.

The Application of Heat in Testing Flours for Cookie Quality
WM. T. YAMAZAKI, Soft Wheat Quality Laboratory, U.S.D.A., Wooster, Ohio

A Micro Dough Expansion Test for Estimating Wheat Quality
HOMER R. ELLING, Western Wheat Quality Laboratory, U.S.D.A., Pullman, Wash.

Some Factors Affecting the Mix Requirements of Wheat Flour Doughs
PAUL MATTERN and R. M. SANDSTEDT, University of Nebraska, Lincoln, Neb.

Some Effects of Oxygen and Fat Upon the Physical and Chemical Properties of Flour Doughs
DONALD E. SMITH, JEROME VAN BUREN, and JOHN ANDREWS, General Mills Research Laboratories, Minneapolis, Minn.

### Baking and Bakery Products

Studies on the Microbiological Populations of Pre-ferments
ROBERT J. ROBINSON, THOMAS H. LORD, JOHN A. JOHNSON, and BYRON S. MILLER, Kansas State College, Manhattan, Kans.

Yeast Fermentation in Brew Processes
SUTTON REDFERN, JOHN A. MASELLI, and FLOYD D. SCHOONOVER, Standard Brands, Inc., Stamford, Conn.

Some Carbonyl Compounds Occurring in Fresh Bread Crust
L. WISEBLATT, American Institute of Baking, Chicago, Ill.

Some Stability Studies on Cereal and Baked Foods for the Canadian Armed Services
J. B. HULSE, Defense Research Medical Laboratories, Toronto, Ontario

Effect of Additives on Crumb Firmness. I. Mono- and Di-glycerides
C. W. OFELT, EARL B. LANCASTER, M. M. MACMASTERS and F. R. SENTI, Northern Utilization Research Branch, U.S.D.A., Peoria, Ill.

Effect of Additives on Crumb Firmness. II. Action of Previously Unreported Additives in Relation to their Chemical Structure

C. W. OFELT, C. L. MEHLTRETTER, J. E. HODGE, F. R. SENTI and M. M. MACMASTERS, Northern Utilization Research Branch, U.S.D.A., Peoria, Ill.

Functional Factors in Icings for Wrapped, Baked Sweetgoods

NAT H. NASH, American Breddo Corp., New York, N.Y.

The Effect of Temperature and Air Velocity on the Freezing and Defrosting Rates of Some Bakery Products

K. KULP and W. G. BECHTEL, American Institute of Baking, Chicago, Ill.

Effects of Storage Temperatures and Ingredients on the Firming of Cake Crumb

J. W. PENCE, NOEL N. STANDRIDGE, MARJORIE HEID, and MAX HANAMOTO, Western Utilization Research Branch, U.S.D.A., Albany, Calif.

White Rings in Frozen Bread

J. W. PENCE, NOEL N. STANDRIDGE, DALE R. BLACK, and FRANCIS T. JONES, Western Utilization Research Branch, U.S.D.A., Albany, Calif.

The Aging of Cracker Flour

JAN MICKA, Sawyer Biscuit Co., Melrose Park, Ill.

Study of the Storage Deterioration and Loss of Performance Value of a Military Prepared Chiffon Cake Mix When Stored at 70° and 100°F.

J. A. MILLER, C. S. MCWILLIAMS, and J. J. MCMULLEN, Quartermaster Food and Container Institute, Chicago, Ill.

Effect of Flour Type and Dispersion Method on the Baking Strength of Spray-Dried Gluten

H. R. SALLANS, Prairie Regional Laboratory, Saskatoon, Saskatchewan

New Developments in Protective Packaging

J. S. BARTON and C. P. OLSTAD, Crown Zellerbach Corp., St. Louis, Mo.

Recent Trends and Developments in Transparent Bakery Packaging

TOM DERBY, American Viscose Corp., Philadelphia, Pa.

Relationship of Glyceride Composition and Processing Methods to Baking Properties of Animal and Vegetable Shortenings in Chemically Leavened and Yeast Fermented Systems

S. W. ARENSON and A. GEISLER, Food Development Laboratory, Baltimore, Md.

Recording Apparatus for Measuring Some Mixing Characteristics of Flour-Water Batters

R. A. ANDERSON and E. B. LANCASTER, Northern Utilization Research Branch, U.S.D.A., Peoria, Ill.

Relationships Between Dough Ingredients, Absorption, and Bread Yield

JOAN BARKER and BARBARA KENNEDY, University of California, Berkeley, Calif.

## General Cereal Science and Technology

The Commercial Potential of Ionizing Radiations for the Cereal Industry — Progress During the Last 12 Months

WOLFGANG HUBER, Consultant, San Francisco, Calif.

Commercial Drying of Western-Grown Rice

T. WASSERMAN, R. E. FERRELL, V. KAUFMAN, and C. SMITH, Western Utilization Research Branch, U.S.D.A., Albany, Calif.

Studies on Wheat Plants Using $C^{14}$ Compounds. VI. Observations on the Biosynthesis of Wheat Kernel Proteins

E. BILINSKI and W. B. MCCONNELL, Prairie Regional Laboratory, Saskatoon, Saskatchewan

Increasing Cereal Content of Feeds Through Unidentified Growth Factor Concentrates

H. G. LUTHER, J. H. HARE and G. A. DONOVAN, Chas. Pfizer and Co., Inc., Terre Haute, Ind.

Effect of Hormones in Feeding of Livestock

H. G. LUTHER, W. M. REYNOLDS, W. C. SHERMAN and E. M. SACCHI, Chas. Pfizer and Co., Inc., Terre Haute, Ind.

Improvements in the Dye-Binding Method of Estimating Protein in Natural Products

DOYLE C. UDY, Western Wheat Quality Laboratory, U.S.D.A., Pullman, Wash.

A Potentiometric Method for the Titration of Mercapto Groups in Wheat Proteins with Iodine

W. C. SCHAEFER, C. A. WILHAM, R. J. DIMLER, and F. R. SENTI, Northern Utilization Research Branch, U.S.D.A., Peoria, Ill.

Antagonism Between Antioxidants

H. S. OLCOTT, Department of Food Technology, University of California, Berkeley, Calif.

Factors Influencing Alpha-Amylase and Protease Activity of Malted Wheat

JAMES R. FLEMING, BYRON S. MILLER, and JOHN A. JOHNSON, Kansas State College, Manhattan, Kans.

Extraction and Chromatographic Determination of Free Amino Acids in Barley and Malt

G. S. ROBBINS, W. J. OLSON, and A. D. DICKSON, Barley and Malt Laboratory, Madison, Wis.

Further Observations on the Growth of Synthetic Starch Crystals

R. M. SANDSTEDT and HELEN SCHROEDER, University of Nebraska, Lincoln, Neb.

Relation of the Cementing Layer and Adjacent Tissues to Germ-Endosperm Separation in Corn

M. J. WOLF and M. M. MACMASTERS, Northern Utilization Research Branch, U.S.D.A., Peoria, Ill.

Function and Valuation of Fats, Oils and Emulsifiers in Food Products

SVEN YOUNG, Canada Packers Ltd., Toronto, Ontario

A Disk Rheometer Applicable to Measuring Shortening Flow Properties

STEPHEN J. LOSKA, JR., and ENDEL JASKA, Pillsbury Mills, Inc., Minneapolis, Minn.

Determination of Baking Quality of Non-Fat Dry Milk by Employing the Protein Dissolving Effects of Urea

R. B. PARKER, Carnation Company, Van Nuys, Calif.

The Availability of Phosphorus in Feed Supplements

J. R. COUCH, Texas A. and M. College, College Station, Texas

Feed Ingredients as Carriers for Micronutrients

J. F. MAHONEY and W. L. BENSON, Merck and Co., Rahway, N.J.

larger cities may completely modify flour packing in France. We have investigated the influence of packing on the quality of flour during storage, particularly in various types of paper bags. Twenty-five types of paper bags have been tested and more than 6000 kilos of flour were stored in over 300 bags. The tests were carried out at constant temperature as well as under conditions similar to industrial practice.

The investigation included the changes at various intervals of storage which occurred in the physico-chemical characteristics of flours (moisture content, acidity, pH); in the plastic qualities of doughs obtained from these flours; in the number of microorganisms; and the life cycle of insects during so-called "antiparasite" packing. The most air-tight sacks accentuated the inherent characteristics of the product. Flour of good quality kept better than poor-quality flours.

*Development of Microorganisms in Wheat and Flour.* The problems occasioned by the storage of grain and flour required a study of the evolution of their microflora, and since 1954 this work has required the services of a microbiologist.

The research started with an examination of the microflora of the wheat grain during ripening. A balance sheet of the microflora of stocks obtained during the milling of wheat corroborated the results obtained by Christensen and Cohen (17).

The influence of temperature and relative humidity on the development of the microflora of flour showed that mold population increased with relative humidity and with temperature up to 35° C. Improved storage was obtained upon decreasing the moisture content to 14.5 to 15%, at any temperature (39).

The action of microorganisms on the biochemical properties of doughs, found by Maes *et al.* (33), has also been investigated.

### Breadmaking

*Yeast.* There are only six yeast plants in France. Their daily output is under the control of the French School for Milling. Each manufacturer is given not only his own results, but also those of his competitors. In this way uniformity in the quality of yeast is fostered. A statistical comparative study of the Berlin Method with the direct measurement of carbonic gas formed in a complete medium permits indirectly, by difference, a prediction of the possible action of yeast proteases on the dough. This factor is difficult to measure directly.

*Desiccation of yeasts* in the presence of flour has been facilitated and accelerated. The mixture is stable at a moisture content of 15% with small loss of fermenting power (9).

Improvement of the fermentation activity of yeast has been investigated as a function of the composition of molasses (Bourdet and Petit, 8), and the relation between the fermentation activity of yeast and cellular synthesis has been studied. The resistance of yeast to autolysis can be measured by determining the phosphorus liberated during autolysis.

The relation of cellular water as compared to the nutrient medium has been investigated by Lindenberg, Petit, and Astoin (31).

The purine and pyrimidine constituents of yeasts have been studied by Bourdet and Mandel (7). By two-dimensional chromatography, 21 nucleotides and 12 nucleosides and the purine and pyrimidine bases present in the free state in the yeast cells were separated and measured.

The amounts of ribose nucleic acid (ARN) and desoxyribose nucleic acid (ADN) contents of the different yeasts were determined and showed that the respective proportions of the purine and pyrimidine nucleotides present in ARN in a polymerized state could be expressed as a constant which is characteristic of the variety, but independent of the earlier developmental conditions of the yeast.

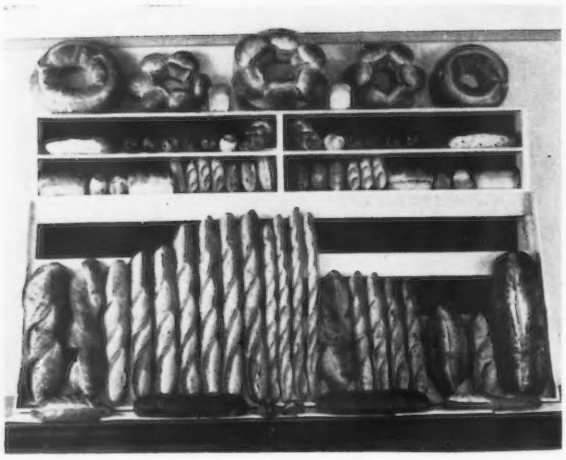
An investigation of the intermediate products of the ribonucleic catabolism of the spontaneously autolyzing cells, or autolysis in the presence of the enzyme activators, enables the study indirectly of the nucleases (mono- and diphosphoesterases, nucleosidases, and desaminases) which develop at the different degradation stages of yeast.

*Alpha-Amylase.* The action of alpha-amylase in breadmaking has been studied in an effort to improve flours with too high amylase activity due to the presence of sprouted wheat in the 1951 and 1954 crops. No new simple remedies have been discovered. Alginates, at a rate of 1.0%, aid in the absorption of water exuded by syneresis during fermentation, but the high cost of this material prohibits its use. For simple control of the amylase activity of a mill mix, alveograms are conducted on flour suspensions and gelled for 30 minutes at 75° C.

In 1950, Chopin introduced the Zymotachygraphe. This instrument reflects certain bread fermentation conditions that are closest to common practice. On only one graph for a single dough, one can obtain a record of the rate of gas production as a function of time, the total volume of carbon dioxide evolved, and the retention of carbon dioxide in the dough. Between 1952 and 1955 the French School for Milling reported the first results obtained with this instrument (13).

*French Breadmaking Practices.* The *quality* of French bread has always been our great concern. The problem is to make attractive and good bread with weak, unbleached, unoxidized wheat flours of 75 to 78% extraction containing from 7.5 to 10% protein ($N \times 5.7$ based on 15% moisture) and an average, or even poor, quality of gluten ($W = 70$ to 120) compared with that of North American wheats.

The breadmaking formulas contain no additions of shortening, sugar, yeast foods, and seldom any supplements (only malted products and ascorbic acid may be used in the bakery), and the bread is baked without the support of tins. The baker must resort to long fermentation times (from 5 to 6 hours at temperatures between 23° and 35° C.) with small percentages of yeast (from 0.6 to



Various types of French bread and rolls found in the average bakery.

1.0%). Frenchmen are fond of their national bread with all its local variations.

Since the publication of the *Journees Scientifiques du Pain* in 1948, several studies have appeared on substitutes in breadmaking, a problem which has recurred for centuries every time great international emergencies arise. A search has been made for yeast toxins similar to the protamin discovered by Balls and Harris (4), employing the different materials used as substitutes for wheat flour. Studies have been made on the main factors which influence the quality of French bread and its staling. These included investigations on the combined action of alcoholic and lactic fermentations, the nonnecessity of enrichment with calcium carbonate, the action of calcium peroxide (particularly on gluten), the use of heated flours, and the influence of tins in manufacturing rusks.

A study of *Streuli* in relation to ropy bread has been completed, and the pre-fermentation with yeast is now being investigated.

*The Physico-Chemical Properties of Doughs Made from Cereal Flours Before and After Baking.* To help clarify the mechanism of some of the phenomena occurring in the more or less moist media containing cereal flours before and after cooking, theoretical studies have been undertaken on relatively simple systems. Particular attention has been given to the nonenzymatic browning reactions, the reactivity of solid substances, the state of their structure, and the state of the water adhering to these substances.

Studies of the reactions occurring in a glucose-glycol solution, in relation to various factors, have permitted the isolation and measurement of different substances, among which are N-glucoside and products of subsequent degradation (35, 36, 37).

Examination under an electron microscope of starch-water dispersions at various temperatures has shown several structural elements and has led to certain hypotheses concerning the structure of the granule (28).

It has been possible to show the influence of interchain associations during drying and of the crystallinity of various carbohydrates on the reactivity of their functional groups and on the mobility of these groups in a high-frequency alternating field (1, 2, 3, 27). A study of the sorption of water by these various carbohydrates has also been undertaken to determine the part played by oxhydryls and their mobility in the fixation of this water. Some practical deductions can be made therefrom, particularly as regards staling.

### Literature Cited


1. ABADIE, P., CHARBONNIERE, R., GIDEL, A., GIRARD, P., and GUILBOT, A. *C.R. Acad. Sci. 240:* 1772–1774 (1955).
2. ABADIE, P., CHARBONNIERE, R., GIDEL, A., GIRARD, P., and GUILBOT, A. *C.R. Acad. Sci. 241:* 1137–1139 (1955).
3. ABADIE, P., CHARBONNIERE, R., GIDEL, A., GIRARD, P., and GUILBOT, A. *C.R. Acad. Sci 241:* 1941–1944 (1955).
4. BALLS, A. K., and HARRIS, T. H. *Cereal Chem. 21:* 74–79 (1944).
5. BOURDET, A. *Revue Ferment. Ind. Alim. 10:* 235–244 (1955).
6. BOURDET, A. *Revue Ferment. Ind. Alim. 11:* 19–33 (1956).
7. BOURDET, A., and MANDEL, P. *C.R. Acad. Sci. 237:* 530–532 (1953).
8. BOURDET, A., and PETIT, L. *Ann. Techn. Agr. 2:* 169–178 (1954).
9. BURÉ, J., and MATTI, H. *Brevet français* P. V. 546,492 du 22 déc. 1947 (Société de stabilisation des levures).
10. BURÉ, J. VII° *Congrés Int. Ind. Agr. Paris* (Juillet 1948).
11. BURÉ, J. *Bull. Meun. Belge 5:* 85–86 (1949).
12. BURÉ, J. *Techn. meun. 43:* 1–8; *44:* 4–10 (1954).
13. BURÉ, J. III° *Congrés Intern. du pain Hamburg* (1955).
14. BURÉ, J. *Brot und Geback 3:* 59–60 (1956).
15. BURÉ, J., and COSSE, MLLE. *C.R. Acad. Agr.* (Mars 1949).
16. BURÉ, J., and LALANNE-HAURET, MME. 10th Congrés Intern. Ind. Agr. et Alim., Madrid (1954).
17. CHRISTENSEN, C. M., and COHEN, M. *Cereal Chem. 27:* 179–185 (1950).
18. COIC, Y. *Ann. I.N.R.A., series A:* 195–204 (1950).
19. COIC, Y. *C.R. Acad. Agr. 36:* 296 (1950).
20. COIC, Y. C.R. Congrés Internat. des engrais chimiques, Rome (1951).
21. FRIEDBERG, L. *Ann. Agr.*, p. 697 (1933).
22. GEDDES, W. F., and LEVINE, M. N. *Cereal Chem. 19:* 547–552 (1942).
23. GESLIN, H. *C.R. Acad. Agr. 35:* 703 (1949).
24. GESLIN, H. *C.R. Acad. Sci. 229:* 898–899 (1949).
25. GUASTALLA. *Rapport Conseil Scient. C.N.E.R.N.A.* (1953).
26. GUILBOT, A. *Unpublished results.*
27. GUILBOT, A., and DRAPRON, R. Congrés Internat. Ind. Alim. Agr., Madrid 1954.
28. GUILBOT, A., and LEVASSEUR, *G. C.R. Acad. Sci. 219:* 728–730 (1954).
29. HOFFER, A., LEVINE, M. N., and GEDDES, W. F. *Cereal Chem. 32:* 347–355 (1955).
30. JONARD, P. Congrés de l'Ass., francaise pour avancement sciences, Tunis (1951). "Les blés tendres cultivés en France"—1 vol. édition I.N.R.A.
31. LINDENBERG, A. B., PETIT, L., and ASTOIN, M. *Bull. Soc. Chim. Biol. 32:* 395–401 (1950).
32. LONGCHAMP, R., ROY, M., and GAUTHERET, R. *C.R. Acad. Sci. 233:* 111, 558 (1951).
33. MAES, E., VAN DEN DRIESSCHE, S., and BERNAERTS, M. *2nd Congrés Int. Ind. Ferment.*
34. MATWEEF, *C.R. Acad. Agr. 39:* (1952).
35. PETIT, L. *9th Congrés Intern. Ind. Agr.*, Rome (1952).
36. PETIT, L. *C.R. Acad Sci. 242:* 829–831 (1956).
37. PETIT, L. Unpublished results.
38. PETIT, L., and PINON. *Bull. Ec. Meun. Belge 12:* 51–62 (1950).
39. POISSON, MME., and GUILBOT, A. *La Meunerie Française 111:* 42–52 (1956).
40. SANDSTEDT, R. M., and BECKORD, O. C. *Cereal Chem. 23:* 548–559 (1946).
41. STOLL, MLLE. *Chimie Analyt. 2:* 33–40 (1954).
42. VIENNOT-BOURGIN, G. *C.R. Acad. Agr. 18:* 729–730 (1952).

# MODERN METHODS OF ANALYSIS APPLICABLE TO CEREAL PROBLEMS[1]

J. HAWTHORN, Department of Food Science, Royal College of Science and Technology, 1 Horselethill Road, Glasgow W.2, Scotland

THE METHODS OF conventional chemistry have been reinforced in recent years by a number of powerful analytical techniques. Indeed, future historians of the subject may well date an era as beginning about the year 1940, because since then there have been more and more numerous applications of new methods which, taken together, represent a revolution in experimental chemistry. Many of these methods were known at least in principle before that date, but for a variety of reasons — not the least of which was the lack of reliable and easily operated commercial instruments — the methods had been the prerogative of specialists. Few references to them will be found in the cereal chemical literature prior to 1940.

To make a large subject manageable, this paper will be confined to methods of analysis which are essentially of a physical nature. Seven techniques of particular interest to workers in the field of cereals will be considered. Also, references to applications of each of these methods are listed, in the hope that inevitable inadequacies in a short paper may be met by the literature.

TABLE I
TECHNIQUES OF POTENTIAL VALUE TO CEREAL CHEMISTRY

| METHOD | AUTHOR(S), DATE,[a] AND TYPICAL EXAMPLES OF APPLICATIONS TO FOOD ANALYSIS |
|---|---|
| CHROMATOGRAPHY | |
| Adsorption | Tswett (1906) — Separation and identification of pigments; isolation of vitamins |
| Partition | Martin & Synge (1941) — Separation and identification of amino acids |
| Filter-paper | Consden, Gordon, & Martin (1944) — Amino acids and sugars; isolation of insecticidal residues |
| Vapor-phase | James & Martin (1952) — Separation and identification of traces of fatty acids; flavoring constituents in foods |
| COUNTERCURRENT SEPARATION | Craig (1944) — Isolation of phospholipids and lipoproteins |
| SPECTROPHOTOMETRY | |
| Ultraviolet | Studies on vitamins; fat oxidation; enzyme assays |
| Infrared | Structure of natural fats; studies of natural pigments |
| POLAROGRAPHY | Heyrovsky (1926) — Enzyme assays; redox systems; vitamin assays |
| ELECTROPHORESIS | |
| Moving-boundary | Tiselius (1937) — Large molecules |
| Filter-paper | Tiselius (1948) — Separation and identification of proteins; gluten constituents |
| ULTRACENTRIFUGE | Svedberg (1926) — Separation, identification, and MW of proteins |
| RADIOACTIVE TRACERS | Hevesy (1923) — Intermediary metabolism; milk production; insecticidal residues |

[a] The dates refer to the first clearly defined description of the technique. Where more than one author (or group of authors) was concerned with a particular method the authors associated with its biological application are quoted.

A glance at Table I, which summarizes these seven techniques, will show that many important developments have been omitted. Photoelectric fluorimetry, ion-exchange resins, X-ray crystallography, flame photometry, and mass spectrography come to mind, but few of these have been applied extensively to cereal chemistry. The table also attempts to indicate the scope of the methods discussed, and although only a few examples are given, it is clear that these methods have wide applications to the study of biological materials. One of the difficulties in discussing modern analytical techniques is that not all their possibilities are known, and many avenues of application have still to be fully explored.

Chromatography was first used in 1906 by an ingenious Russian botanist named Tswett, but its recent and extensive development stems from the well-known paper of Martin and Synge in 1941 (92) in which they first described partition chromatography. The further paper by Consden, Gordon, and Martin in 1944 (89) on paper chromatography loosed a flood of work on this subject which has made the methods so familiar as to require no further description here.

### Vapor-Phase Chromatography

However, the recently developed technique of vapor-phase chromatography, again associated with the name of Martin and his colleagues, is opening up new and interesting possibilities. Its theory, an extension of that of ordinary partition chromatography, is dealt with in detail by James and Martin (6). The equipment used has varied from one author to another, but Fig. 1, taken from a paper by Ray (12), illustrates the principles involved.

The chromatographic tube is packed with a mixture of Kieselguhr as a supporting medium, which is wetted with a suitable liquid phase. A number of substances including "dinonyl" phthalate (di-(3:5:5-trimethylhexylphthalate)), liquid paraffin, DC 550 silicone fluid (with or without an added 10% stearic acid), glycerol, lubrol MO, and others have been used for this purpose. The tube (total length 6 ft.) is surrounded by a jacket fitted with a boiler and condenser which enables it to be held at the temperature most suited to the separation in hand. The column is continuously flushed by the mobile phase, which is normally a stream of nitrogen gas fed through at a controlled rate. The material to be analyzed is introduced at the top of the column from, in this case, a micrometer syringe, and the various components pass along at a rate which is a function of the partition coefficient of the material between the mobile gas phase and the stationary liquid phase. They emerge from the end of the column in a series with the compounds of increasing molecular weight appearing in that order.

On emerging from the column the individual components pass through a detection cell. Numerous devices have

[1] Manuscript received December 4, 1956. Presented at the Symposium on Recent Advances in the Chemistry and Industrial Applications of Cereals, held by the Royal Institute of Chemistry at the University of St. Andrews, Scotland, June 1956.

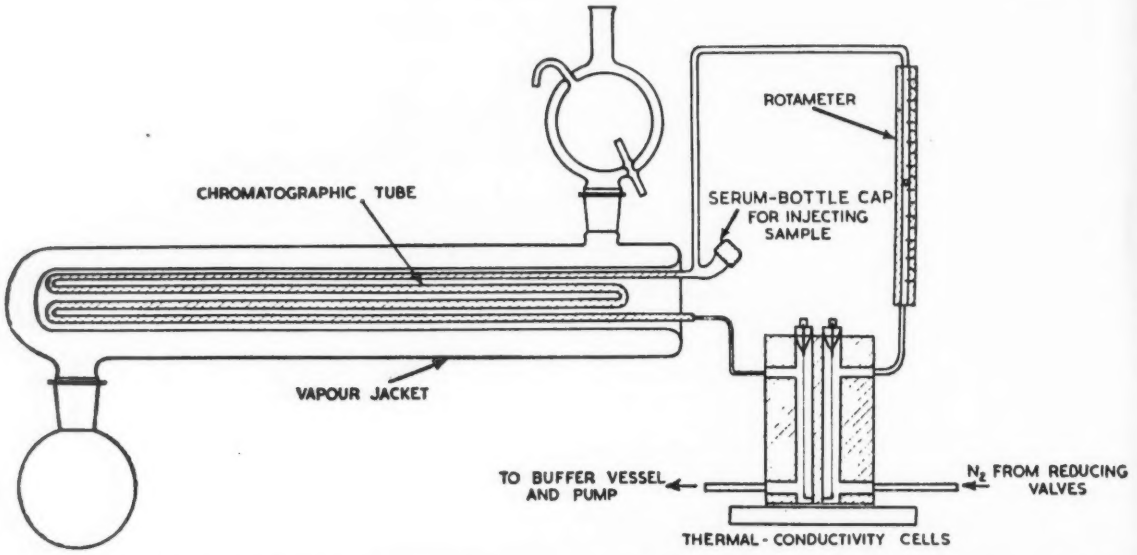



Fig. 1. Diagram illustrating the construction of a vapor-phase chromatography unit; chromatographic column and thermal-conductivity cells. (From: Ray, N. H. J. Appl. Chem. 4: 21 (1954), reproduced with permission of publishers of the journal.)

been proposed for this purpose and the thermal-conductivity cell illustrated is one of the most popular of these, although automatic microtitrating equipment and gas density balances have also been very successfully employed. In the example illustrated, the two platinum wires form two arms of a Wheatstone bridge, the other two arms being coils of the same resistance (25 ohms). Because of variations in the thermal conductivity of the gas stream, the wire on the left-hand side of the apparatus undergoes a small temperature change as a compound comes through the system. This alters its resistance, and the resulting out-of-balance potential is fed through a suitable amplifying circuit to a pen recorder. A commercial form of the apparatus is shown in Fig. 2.

The tracing recorded by the apparatus shows a series of steps or peaks (depending on the detecting system used), each peak being characteristic of one of the components of the system. Figure 3 (12) illustrates the separation of a series of esters; Fig. 4 (8) shows the analysis of the fatty acids in goat-milk fat. Under suitable conditions, complete analysis of a few milligrams of material can be carried out.

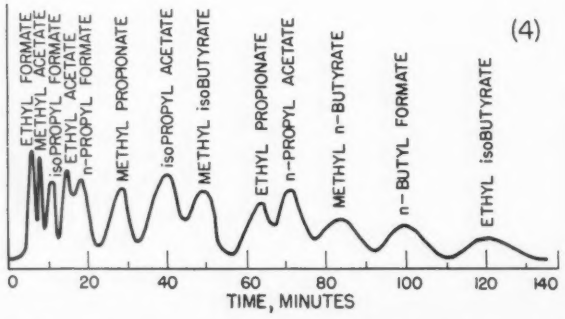
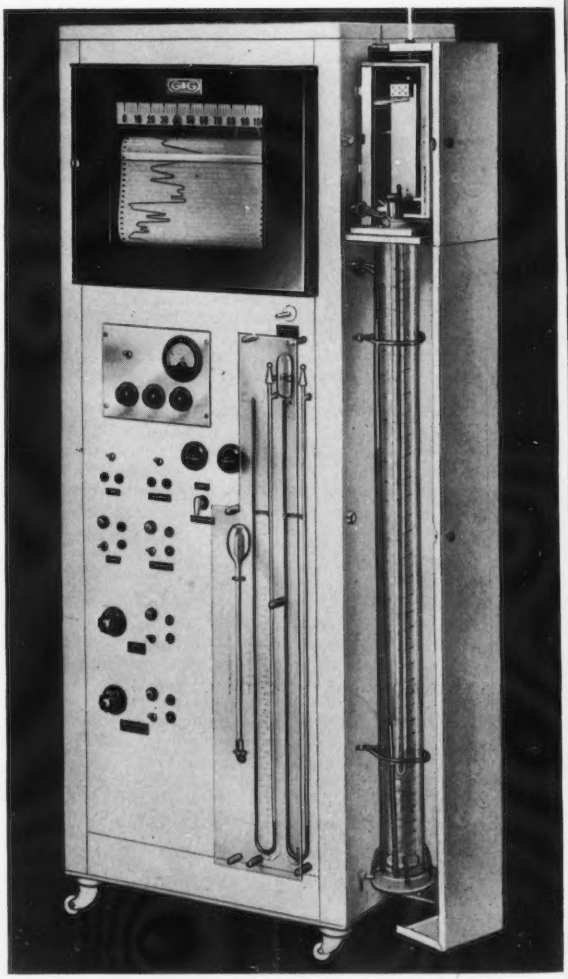



Fig. 3. The separation of a series of esters by vapor-phase chromatography. (From: Ray, N. H. J. Appl. Chem. 4: 21 (1954), reproduced with permission of publishers of the journal.)

Fig. 2. A commercially available apparatus for vapor-phase chromatography. (Griffin & George Ltd., England.)



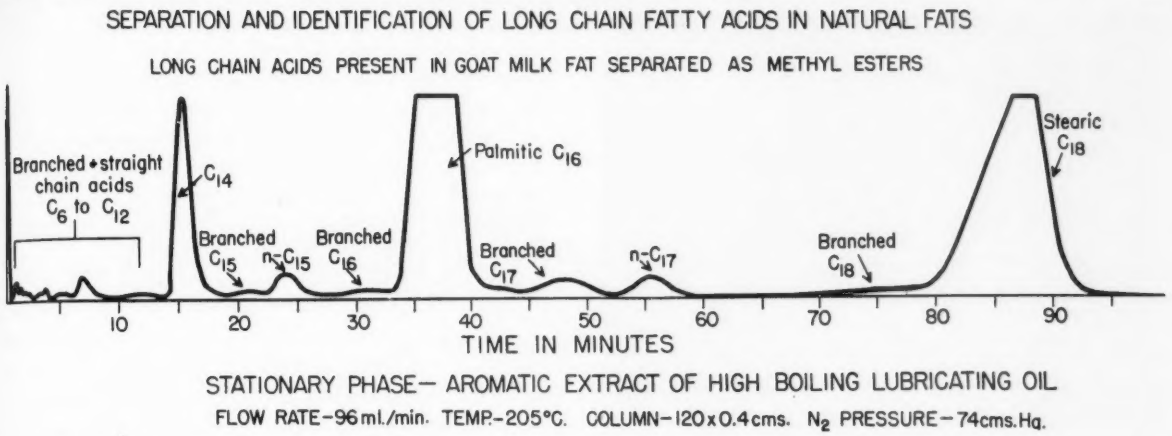



Fig. 4. The separation of 8 mg. of the methyl esters of the fatty acids present in goat-milk fat by vapor-phase chromatography. The stationary phase was an aromatic fraction from a high-boiling lubricating oil. (From: James, A. T., and Martin, A. J. P. Biochem. J. 63: 144 (1956); reproduced with permission of journal publisher and senior author.)

Gas chromatography offers promise in two fields of interest to cereal chemists. The baking properties of wheat flour depend at least to some extent on the lipid fraction, as has been illustrated by two recent papers (24, 91); yet it appears certain that only one fatty-acid analysis (90) of wheat-germ oil has ever been published. Here is a method so simple and rapid that a large number of comparative fatty-acid analyses of oils from different wheat samples could readily be carried out and possibly correlated with baking properties.

The second interesting possibility has already been seized on by Berridge and Watts (2) of the National Institute for Research in Dairying. The characteristic flavor of blue-vein cheese is due to the presence of methyl ketones which are mold metabolites, and attempts have been made to separate and identify these. Adequate separations by conventional chromatography were not achieved over many tests, but excellent separations were obtained by vapor-phase chromatography, as shown in Fig. 5. Since the quantities are plotted in micromoles the very small amounts of material required for analysis can be appreciated. This work of Berridge and Watts, coupled with observations of Ray and others (4, 12) on the ease of separation of esters and ethers, raises the fascinating possibility of the use of vapor-phase chromatography to study traces of natural flavoring materials in foodstuffs.

Craftsman bakers of the old school complain rather bitterly about the lack of flavor in factory-made bread and attribute this to overrapid fermentation. They may well be correct. Certainly their samples of bread, made by the old-fashioned slow sponge-and-dough processes, or made with barm, are more acceptable to the author's palate than commercial bread. The difference must surely lie in the metabolites of the microflora. Perhaps at a later stage of its development, gas-liquid chromatography will have information to divulge on this interesting problem.

### Countercurrent Separation

Countercurrent separation is a technique associated with the name of Craig, who in 1944 suggested a continuous apparatus for the old method of partitioning an impure material between two immiscible solvents, in one of which the impurity was more soluble than the material. To obtain high standards of purity many tedious separations might be required, and Craig proposed an ingenious piece of equipment which carried out successive separations semiautomatically, over a large number of stages (16).

Figure 6 illustrates a modern apparatus designed on the Craig principle. The battery of 50 partition tubes is mounted on a common housing, and the unit can be provided with either manual or automatic operating mechanisms. Figure 7 shows a single tube at each of the three stages of the process. The three essential stages in the

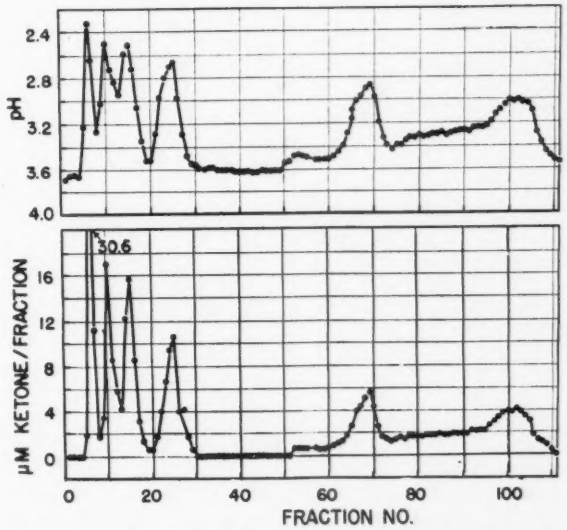



Fig. 5. Separation of methyl ketones by vapor-phase chromatography. The peaks (left to right) are acetone, ethyl methyl ketone, methyl isopropyl ketone, isobutyl methyl ketone, methyl pentyl ketone, hexyl methyl ketone, and methyl nonyl ketone. The upper curve shows the pH value of the column effluent; the lower curve, total ketone. (From: Berridge, N. J., and Watts, J. D. J. Sci. Food Agr. 5: 417 (1954); reproduced with permission of journal publisher.)

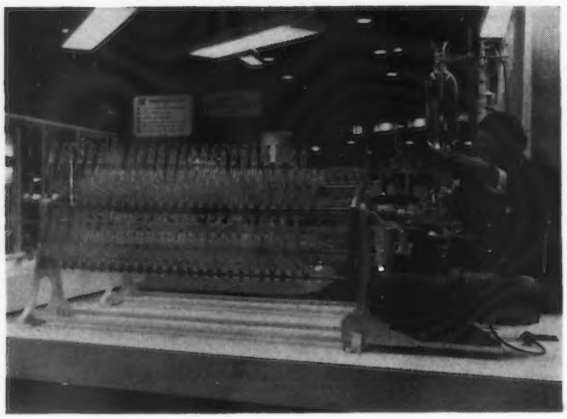


Fig. 6. A countercurrent separation apparatus. (Quickfit and Quartz, England.)

extraction process are: Stage 1, *agitation*, when the actual extraction of the solid by the solvent occurs. The degree of movement and duration of this stage is variable to suit the conditions as required. Stage 2, *settling*, in which the apparatus stands while the two layers separate out. Again, the time for this operation is variable according to conditions. Stage 3, *transfer*, in which the tubes are allowed to stand in a vertical position, when the top layer runs into the transfer vessel. Stage 1 is immediately started again and each top layer moves on to the next tube. When the tubes are returned to their initial position the hyperphases throughout the series move up one tube.

current distribution as shown in Fig. 8 (88). In this example, methyl linoleate was oxidized to a level of 0.62 moles of oxygen per mole of ester. The peak on the right-hand side of the curve is the unoxidized methyl linoleate; the middle peak is the primary oxidation product, methyl linoleate hydroperoxide; the peak on the left-hand side is due to secondary oxidation products. At low levels of oxidation, the left-hand peak is negligible or nonexistent. With countercurrent distribution methods, it can be shown that at low levels of oxidation one molecule of hydroperoxide is formed for each molecule of oxygen absorbed. Few chemists interested in problems of fat rancidity would deny that this isolation of methyl linoleate hydroperoxide is a major achievement, and the example illustrates the comparative ease with which labile materials may be handled by this method.

### Role of Lipids in Baking

It may be felt that undue attention is being paid to the analysis of lipids. There is justification for cereal chemists' taking a much closer look at the fatty constituents in their raw materials. Coppock and his colleagues Cookson, Laney, and Axford of the British Baking Industries Research Association have recently published three papers which, taken together, represent an extensive study of the role of lipids in baking (15, 24). Their investigations started with a study of the effects of glyceryl monostearate (GMS) on baking, and their results led them to consider the part played by the flour oil itself in determining the

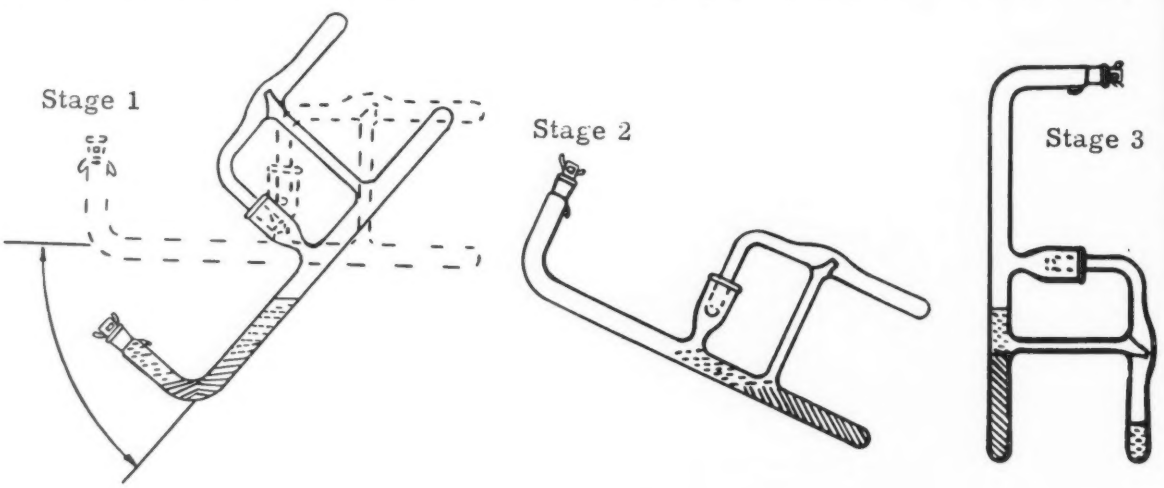



Fig. 7. Mode of operation of individual tubes of the apparatus shown in Fig. 6.

The method developed into something more than a means of purification, and substances which had hitherto been separable only with great difficulty were separated readily. Countercurrent separation has found its greatest application in fat chemistry, but has also been applied in antibiotics, alkaloids, and polypeptides. The separation, for example, of fatty oxidation products has had little success with chromatographic methods, but the oxidation products of methyl linoleate may be separated by counter-

quality of bread. For example, they found that a good loaf could be obtained from defatted flour, but the addition of shortening or GMS to doughs made from defatted flours gave poorer loaves — the reverse of what happens when these substances are added to normal doughs. However, a phosphatide which they separated from flour oil had an almost spectacular improving effect on defatted flour when added at the low level of 0.003%. They were also able to show that this crude phosphatide would partly

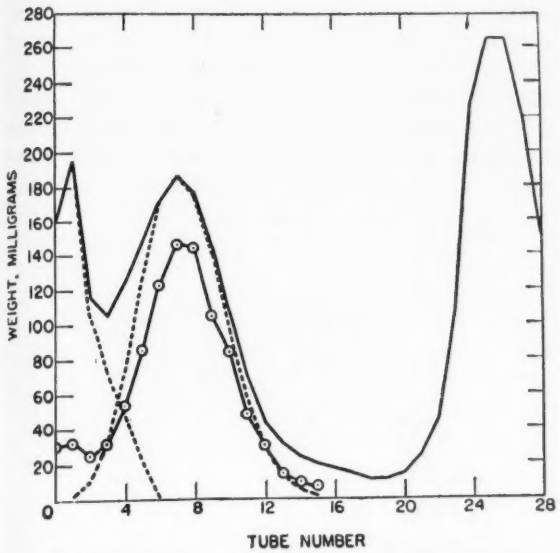



Fig. 8. Weight-distribution curve (solid line) obtained by countercurrent fractionation of autoxidized methyl linoleate (0.62 mole oxygen absorbed per mole of linoleate). The circles indicate weights of diene-conjugated esters. The broken line at the center is the theoretical curve; that on the left, the difference curve. (From: Dutton, H. J. J. Am. Oil Chemists' Soc. 32: 652 (1955); reproduced with permission of journal publisher.)

reverse the volume-inhibiting effect of GMS on defatted flours. These results are of particular interest in connection with theories of the action of improvers. Is it not possible that the assumption that improvers affect only gluten is unjustified? For many years the controversy over the action of improvers in bread doughs has been between the Jorgenson and Sullivan schools of papain inhibition and sulfhydryl oxidation theories, respectively. Protagonists of both schools have tended to assume that improvement was concerned solely with gluten proteins, yet in 1947 Olcott and Mecham (93) published an account of a convincing series of experiments in which they demonstrated that as soon as a dough was mixed most of the lipid present became bound to protein. Coppock and his colleagues followed up their observations on the improving effect of the phosphatides by carrying out a countercurrent separation of the isolated phosphatide, with the results shown in Fig. 9. From this curve, it is clear that their phosphatide improver contained at least five different components, and they showed that the differences were real from the nitrogen/phosphorus ratios in the fractions. Further development of this work may be of great significance in our concept of improver action.

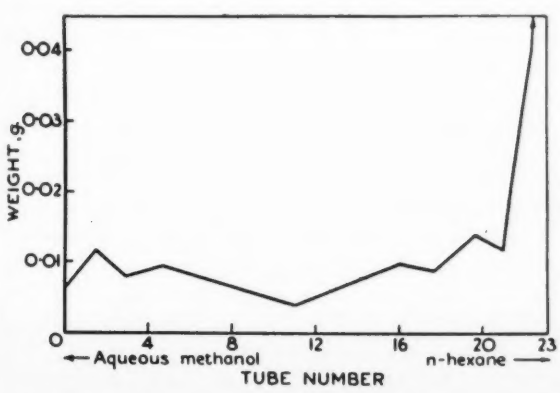



Fig. 9. A countercurrent distribution curve of flour lipid.

### Spectrophotometry

Spectrophotometry is concerned with the measurement of two factors: the fraction of radiation transmitted through a given sample, and the wave length of the transmitted light. The fact that equipment used may be complex and perhaps, but not necessarily, very costly, makes no difference to the basic simplicity of the operation, and a detailed knowledge of these two factors is directly related to the molecular structure of the absorbing material. Basically, then, a spectrophotometer is a device with two knobs: when one of these is turned, a beam of light of a selected wave length passes through the sample; when the other is turned, the fraction of the incident radiation which is absorbed by the sample is read on a dial.

An application which illustrates the convenience of spectrophotometry is to be found in Coppock's paper (24), referred to in connection with countercurrent separation. Evidence having been obtained that a lipid fraction had a remarkable effect on bread quality, especially when defatted flours were used, an examination was made of the unsaponifiable matter derived from an 85% extraction flour, and the fat from bread prepared from it both before and after treatment with Agene. The results are shown in Fig. 10. The change in absorption spec-

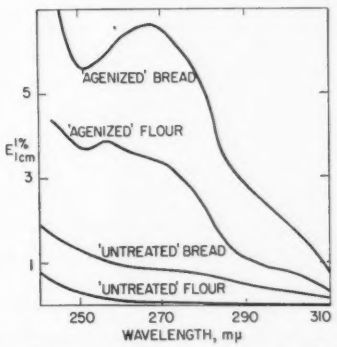



Fig. 10. Ultraviolet absorption spectra of unsaponifiable lipid fractions from flour and bread showing the effect of Agene on these fractions. (Figs. 9 and 10 are reproduced from: Cookson, M. A., and Coppock, J. B. M. J. Sci. Food Agr. 7: 72 (1956), with permission of the journal publisher.)

trum on Agene treatment provides conclusive evidence that, whatever else it may do, Agene brings about changes in the lipid fraction. This evidence is not sufficient to say what these changes are, but it is sufficient to justify a further examination of these lipids. It would have been easily possible to obtain such curves from less than 0.1 g. of material in a couple of hours' work. It is doubtful whether any other technique could have demonstrated these differences so simply and quickly. Thus, in addition to its well-known analytical applications, spectrophotometry can be a useful tool to show that chemical reactions

have taken place even if we do not know the nature of the reactions.

### Polarography

To a newcomer entering the field, especially one who has neglected electrochemistry since undergraduate days, the literature on polarography looks formidable; but the underlying principle is simple. A suitably buffered solution containing the reducible substance under analysis is placed in an electrolysis cell in which a glass capillary with mercury dropping from it serves as the cathode, the anode being any suitable half-cell such as the saturated calomel electrode. A gradually increasing potential is applied to the cell and the resulting current is plotted against the applied voltage. The mercury cathode is used because its surface is continually renewed and it therefore does not become fouled with products of electrolysis. At first sight it would be expected that the current-voltage curves would simply follow Ohm's law. However, a small electrode such as a drop of mercury is easily polarized (hence "polarography"), and the resulting curves rise in a series of steps, known as polarographic waves, the position of the step on the voltage scale being characteristic of the substance being reduced at the cathode, while the height of the step is proportional to the concentration of the substance.

Fig. 11. A polarographic electrode assembly. (Cambridge Instrument Co. Ltd., England.)

The polarograph (Figs. 11 and 12) has not been widely used in cereal studies, but since it is used to measure the concentration of reacting substances in oxidation-reduction systems, attempts have been made to apply it to studies of flour improvement. Using it in 1941, Laitinen and Sullivan (48) were able to demonstrate cysteinelike waves in flour extracts, while last year, two Dutch workers (42) applied it to the measurement of the apparent sulfhydryl content of wheat proteins. In the author's laboratory much interest has been taken in the fact that when wheat flour is wetted, as for example in the preparation of a bread dough, the resulting dough is reducing in character and will absorb atmospheric oxygen. This phenomenon gives rise to a modest degree of improvement during normal dough mixing, but if suitable conditions in the dough mixer are provided, as exemplified by the well-known Rank and Hay batter process (94) or the oxygen process proposed by the author's laboratory (91), excellent bread can be made without any flour treatment whatever in the ordinary chemical sense. The fact that free oxygen is thus capable of acting as a bread improver led to a search for methods by means of which the oxygen uptake of flour/water suspensions could be measured.

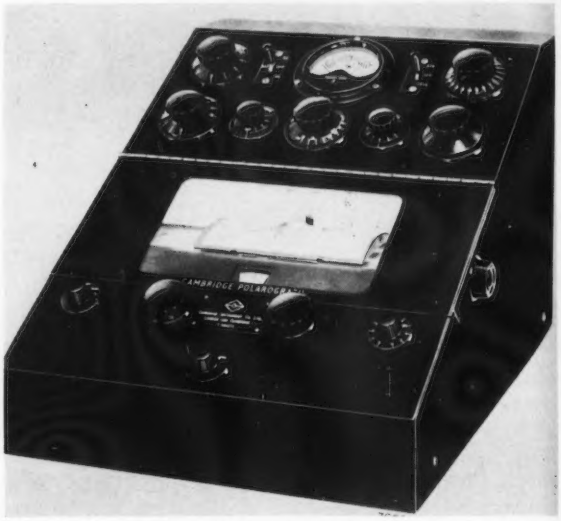


Fig. 12. A pen-recording polarograph. (Cambridge Instrument Co. Ltd., England.)

TABLE II

OXYGEN EQUIVALENTS OF SOME COMMERCIAL BLEACHERS AND IMPROVERS

| AGENT | AVAILABLE OXYGEN | TYPICAL DOSAGE | OXYGEN EQUIVALENT OF AGENT (at S.T.P./lb.) | |
|---|---|---|---|---|
| | % | *p.p.m.* | *p.p.m.* | *ml.* |
| Nitrogen trichloride | 19.9 | 60 | 12 | 3.8 |
| Chlorine dioxide | 59.4 | 30 | 18 | 5.7 |
| Benzoyl peroxide | 6.6 | 15 | 1 | 0.3 |
| Potassium bromate | 28.7 | 20 | 6 | 1.9 |
| Ammonium persulfate | 7.0 | 160 | 11 | 3.5 |

On the assumption that existing bleaching and improving agents may be used as a model, Table II shows the oxygen equivalent of typical levels of treatment. It is clear that the problem of measuring an uptake of this order is a considerable one.

Several authors have described the application of the polarograph to the measurement of the oxygen uptake of tissues and blood proteins. They reported the method to be much more sensitive than the conventional Warburg apparatus, and in the author's laboratory therefore an attempt has been made to apply it to measuring the oxygen uptake of flour suspensions.

If oxygen is present in a polarographic cell it is reduced in two equal steps, the first corresponding to its reduction to hydrogen peroxide and the second to the reduction of hydrogen peroxide to hydroxyl ions. In most the applications of infrared spectrophotometry and de-

ly recording infrared spectrophotometers, a sorter, and files of punched cards, will differ greatly in appearance scribing a machine for sorting infrared spectra recorded on punched cards. He says, "This technique is no longer polarographic work the presence of oxygen is a nuisance because it interferes with the reduction of other substances and has to be removed by passing hydrogen through the cell. On the other hand, if one wishes to measure changes in the oxygen concentration of a solution, the polarograph offers a convenient and sensitive method of doing so. On this basis a method of measuring the oxygen uptake of wheat flours suspended in buffer solutions has been devised.

TABLE III

SOME POLAROGRAPHIC OBSERVATIONS ON THE OXYGEN UPTAKE OF FLOUR SUSPENSIONS

| FLOUR USED | pH USED AND OXYGEN UPTAKE[a] | | |
|---|---|---|---|
| | pH 6.0 | pH 4.5 | pH 4.5[b] |
| | *ml/lb* | *ml/lb* | *ml/lb* |
| Control (unbleached, untreated) | 2.9 | 3.9 | 4.9 |
| Agene-treated | 2.6 | 3.2 | 3.2 |
| Electric arc | 2.4 | 3.3 | 3.9 |
| Ozone | 2.2 | 3.6 | 2.9 |

[a] Ml/lb at S.T.P.
[b] Defatted flours used for these data.

Table III shows some of the results obtained by this method.[2] The observed oxygen uptake is of the order calculated from the amounts of bleachers and improvers used. Treated flours absorb less oxygen than untreated flours.

### Electrophoresis and the Ultracentrifuge

Some mention should be made of the two outstanding methods of protein separation which have been applied to the examination of cereal proteins during the past few years. Protein studies have required the evolution of new laboratory methods, and of these electrophoresis, the movement of protein particles under the influence of an electric field, and ultracentrifugation, the movement of particles under the influence of a high gravity field, have been indispensable aids to a better understanding of the problems in this field during the past fifteen or twenty years.

From the strictly practical point of view it is doubtful whether anything of immediate value to the cereal technologist has arisen from the studies which have been made so far in this field. Ultracentrifuges are costly and available only in specialized laboratories. The original Tiselius apparatus for electrophoresis by the moving-boundary method was extremely costly and very bulky. The development of electrophoresis on filter paper about 1948 made possible the use of inexpensive apparatus for this purpose, and miniature equipment on the moving-boundary principle which has been developed in the past year or two has brought about the possibility of more general use of this method.

In the medical field, filter-paper electrophoresis has found a major application in the separation of plasma proteins and has been used as a diagnostic method for a number of pathological conditions. Using parallel methods, a series of papers by Pence and his colleagues (63, 64, 65) has compared the distribution of proteins in the albumin fractions of wheat by filter-paper electrophoresis, and marked differences between different wheats have been demonstrated. The apparatus required is not very expensive and the method could be used in a routine fashion. Attention is drawn to this work because of the interesting possibility of its ultimate use as a quality prediction test for wheat and flour. While much of the published work savors of the exploratory rather than the conclusive, our most intractable practical problems often are due to some aspect of protein behavior, and it is clear that the solution of these problems is dependent on the laying of firm foundations to knowledge of cereal proteins.

### Radioactive Tracer Methods

The use of radioactive and other isotopes as analytical tags has been developed since the middle 1930's, although their first recorded use goes back to 1923. The most important sources of these particles are the cyclotron and the atomic pile. With the building of large nuclear reactors, radioactive isotopes have become readily available at moderate cost and they undoubtedly will be put to increasing use in the future.

Moreover, radioactive fall-out from hydrogen-bomb explosions is beginning to appear in foodstuffs. It is not beyond the bounds of possibility that we may all be forced to take an increasing interest in the measurement of traces of radioactivity.

In cereal chemistry, some applications of the use of radioisotopes have been made in recent years. Sulfhydryl groups have been determined in flour by Nordin and Spencer (80), while radioactive glucose has been used in the study of metabolic processes in yeast (73, 74) during the leavening of bread. In addition to these examples, comparatively extensive studies on the fate of insecticides in food products have been made. There is a noteworthy series of papers by Winteringham (85, 86, 87) on the ultimate fate of methyl bromide residues arising from the fumigation of wheat. It has been known for some time that the residual fumigant retained by cereals was almost entirely decomposed with the formation of inorganic bromide. Not only the question of the toxicity of methyl bromide is raised, but also the question of the toxicity of the possible derivatives which it might form with the flour constituents. In a very elegant piece of work, Winteringham and his colleagues used radioactive isotopes to identify the derivatives formed, and this enabled subsequent toxicological studies to be made on a more rational basis.

In concluding this very brief survey, the author would like to quote from a review by O'Connor (35) discussing a wild proposal. The analytical laboratory of tomorrow, consisting of merely one or more streamlined automatical- from the typical wet-method analytical laboratory of today."

[2] Hawthorn, J. Unpublished data.

O'Connor's automatic laboratory will apply only to qualitative analysis, and it will be a very long time before physical methods completely supersede more conventional methods. Meantime they are to be regarded as valuable analytical aids in the armory of the cereal chemist.

### Bibliography

The following references have been selected either as important sources of information on a specific method of analysis, or because of their general interest in relation to the subject matter. In no sense do they represent a complete bibliography.

#### Vapor-phase chromatography


1. AMBROSE, D., and COLLERSON, R. R. Nature *177:* 84 (1956).
2. BERRIDGE, N. J., and WATTS, J. D. J. Sci. Food Agric. *5:* 417 (1954).
3. DESTY, D. E., and HARBOURN, C. L. A. (eds.). Symposium on vapor-phase chromatography. Butterworth: London (1956).
4. DIMMICK, K. P., and CORSE, J. Food Technol. *10:* 360 (1956).
5. JAMES, A. T. Biochem. J. *52:* 242 (1952).
6. JAMES, A. T., and MARTIN, A. J. P. Biochem. J. *50:* 679 (1952).
7. JAMES, A. T., and MARTIN, A. J. P. Analyst *77:* 915 (1952).
8. JAMES, A. T., and MARTIN, A. J. P. Biochem. J. *63:* 144 (1956).
9. JAMES, A. T., MARTIN, A. J. P., and SMITH, G. H. Biochem. J. *52:* 238 (1952).
10. MARTIN, A. J. P., and JAMES, A. T. Biochem. J. *63:* 138 (1956).
11. PHILLIPS, C. Gas chromatography. Butterworth: London (1956).
12. RAY, N. H. J. Appl. Chem. *4:* 21 (1954).
13. RAY, N. H. J. Appl. Chem. *4:* 83 (1954).


#### Countercurrent distribution


14. COOKSON, M. A., and LANEY, D. H. Chem. & Ind., p. 450 (1954).
15. COPPOCK, J. B. M., COOKSON, M. A., LANEY, D. H., and AXFORD, D. W. E. J. Sci. Food Agric. *5:* 8, 19 (1954).
16. CRAIG, L. C. J. Biol. Chem. *155:* 519 (1944).
17. CRAIG, L. C., and POST, O. Anal. Chem. *21:* 500 (1949).
18. DAVIES, L. S., and EDWARDS, W. G. H. J. Sci. Food Agric. *2:* 431 (1951).
19. DUTTON, H. J. J. Am. Oil Chemists' Soc. *32:* 652 (1955).
20. PERRY, E. S., and BROKAW, G. Y. J. Am. Oil Chemists' Soc. *32:* 191 (1955).


#### Spectrophotometry


21. AHLERS, N. H. E. Chem. & Ind., p. 93 (1956).
22. AHLERS, N. H. E., and MCTAGGART, N. G. J. Sci. Food Agric. *5:* 75 (1954).
23. COLE, E. W., and MILNER, M. Cereal Chem. *30:* 378 (1953).
24. COOKSON, M. A., and COPPOCK, J. B. M. J. Sci. Food Agric. *7:* 72 (1956).
25. ENSLIN, P. R. J. Sci. Food Agric. *5:* 410 (1954).
26. GORE, R. C. Anal. Chem. *26:* 11 (1954).
27. GOULDEN, J. D. S. Nature *177:* 85 (1956).
28. HERB, S. F. J. Am. Oil Chemists' Soc. *32:* 153 (1955).
29. KUNKEL, H. G. Archiv. Biochem. *30:* 306 (1951).
30. LOTHIAN, G. F. Absorption spectrophotometry. Hilger and Watts Ltd.: London (1949).
31. LUNN, A. K., and MORTON, R. A. Analyst *77:* 718 (1952).
32. MATZ, S. A., and LARSEN, R. A. Cereal Chem. *31:* 73 (1954).
33. MILNER, M., and DODGE, W. W. Cereal Chem. *27:* 501 (1950).
34. O'CONNOR, R. T. J. Am. Oil Chemists' Soc. *32:* 616 (1955).
35. O'CONNOR, R. T. J. Am. Oil Chemists' Soc. *32:* 624 (1955).
36. O'CONNOR, R. T. J. Am. Oil Chemists' Soc. *33:* 1 (1956).
37. SHEPPARD, N. Analyst *77:* 732 (1952).


#### Polarography


38. AIREY, L., and SMALES, A. A. Analyst *75:* 287 (1950).
39. BARKER, G. C., and JENKINS, I. L. Analyst *77:* 685 (1952).
40. BEECHER, H. K., FOLLANSBEE, R., MURPHY, A. J., and CRAIG, F. N. J. Biol. Chem. *146:* 197 (1942).
41. BERNHART, F. W. J. Biol. Chem. *128:* 289 (1939).
42. DE LANGE, P., and HINTZER, H. M. R. Cereal Chem. *32:* 307 (1955).
43. DE LANGE, P., and HINTZER, H. M. R. Cereal Chem. *32:* 314 (1955).
44. FIALA, S. Biochem. Z. *318:* 67 (1948).
45. JONES, F. R., and BRASHER, D. M. Analyst *72:* 423 (1947).
46. KOLTHOFF, I. M., and LINGANE, J. J. Polarography, Vols. I and II (2nd ed.). Interscience: New York (1952).
47. KOLTHOFF, I. M., STRICKS, W., and MORREN, L. Anal. Chem. *26:* 366 (1954).
48. LAITINEN, H. A., and SULLIVAN, B. Cereal Chem. *18:* 60 (1941).
49. LEWIS, V. M., and MCKENZIE, H. A. Anal. Chem. *19:* 643 (1947).
50. LEVINE, H. S., and WILLIAMS, O. J. Anal. Chem. *26:* 1297 (1954).
51. LINDQUIST, J. R. Food Industries *19:* 182 (1947).
52. MULLER, O. H. The polarographic method of analysis (2nd ed.). Chemical Education Publishing Co.: Easton, Pa. (1951).
53. PETERING, H. G., and DANIELS, F. Trans. Am. Chem. Soc. *60* (2): 2796 (1938).
54. PRATER, A. N., JOHNSTON, C. M., POOL, M. F., and MACKINNEY, G. Ind. Eng. Chem. (Anal. Ed.) *16:* 153 (1944).
55. URION, E. Brasserie *9:* 72 (1954).
56. WÖSTMANN, B. Cereal Chem. *27:* 391 (1950).


#### Electrophoresis and the ultracentrifuge


57. BARNETT, A. J. G., and SMITH, D. K. J. Sci. Food Agric. *6:* 53 (1955).
58. CREMER, H. O., and TISELIUS, A. Biochem. Z. *320:* 273 (1950).
59. FOSTER, J. F., YANG, J. T., and YUI, N. H. Cereal Chem. *27:* 477 (1950).
60. KUNKEL, H. G., and TISELIUS, A. J. Gen. Physiol. *35:* 89 (1951).
61. LAWS, W. D., and FRANCE, W. G. Cereal Chem. *25:* 231 (1948).
62. NAISMITH, W. E. F. J. Sci. Food Agric. *6:* 721 (1955).
63. PENCE, J. W. Cereal Chem. *30:* 328 (1953).
64. PENCE, J. W., and ELDER, ANGELINE H. Cereal Chem. *30:* 275 (1953).
65. PENCE, J. W., WEINSTEIN, N. E., and MECHAM, D. K. Cereal Chem. *31:* 396 (1954).
66. POOL, A. A., and SHOOTER, E. M. J. Sci. Food Agric. *6:* 514, 524, 534 (1955).
67. SCHWARZ, V. Nature *167:* 404 (1951).
68. SCHWIMMER, S., and GARIBALDI, J. A. Cereal Chem. *29:* 108 (1952).
69. TISELIUS, A. Biochem J. *31:* 1464 (1937).
70. TISELIUS, A. Discussions Faraday Soc. *13:* 29 (1953).


#### Radioactive tracers


71. ALLENTOFF, N., PHILLIPS, W. R., and JOHNSTON, F. B. J. Sci. Food Agric. *5:* 231 (1954).
72. ALLENTOFF, N., PHILLIPS, W. R., and JOHNSTON, F. B. J. Sci. Food Agric. *5:* 234 (1954).
73. AUBERT, J. P., and MILHAUD, G. C. R. Acad. Sci. Paris *240:* 1943 (1955).
74. AUBERT, J. P., and MILHAUD, G. Peaceful Uses of Atomic Energy, United Nations *12:* 98 (1956).
75. BRIDGES, R. G. J. Sci. Food Agric. *6:* 261 (1955).
76. BRIDGES, R. G. J. Sci. Food Agric. *7:* 305 (1956).
77. COMAR, C. L. Radioisotopes in biology and agriculture. McGraw-Hill: London (1955).
78. FRANCIS, G. E., MULLIGAN, W., and WORMALL, A. Isotopic tracers. Athlone Press: London (1954).
79. HEVESY, G. Radioactive indicators. Interscience: New York (1948).
80. NORDIN, P., and SPENCER, E. Y. Cereal Chem. *29:* 29 (1952).
81. POPJAK, G. Royal Institute of Chemistry Monographs, No. 2 (1955).
82. SPINKS, J. W. T., and TOLLEFSON, C. I. Cereal Chem. *25:* 139 (1948).
83. STEIN, L. H., ALPER, T., and ANDERSSEN, E. E. J. Sci. Food Agric. *3:* 31 (1952).
84. TYLER, C. J. Sci. Food Agric. *5:* 335 (1954).
85. WINTERINGHAM, F. P. W. J. Sci. Food Agric. *6:* 269 (1955).
86. WINTERINGHAM, F. P. W., HARRISON, A., BRIDGES, R. G., and BRIDGES, PATRICIA M. J. Sci. Food Agric. *6:* 251 (1955).
87. WINTERINGHAM, F. P. W., HARRISON, A., JONES, C. R., MCGIRR, J. L., and TEMPLETON, W. H. J. Sci. Food Agric. *1:* 214 (1950).


The following papers are cited in the text but are not specifically concerned with techniques.


88. CANNON, J. A., ZILCH, K. T., BURKET, S. C., and DUTTON, H. J. J. Am. Oil Chemists' Soc. *29:* 447 (1952).
89. CONSDEN, R., GORDON, A. H., and MARTIN, A. J. P. Biochem. J. *38:* 224 (1944).
90. GUNSTONE, F. D., and HILDITCH, T. P. J. Soc. Chem. Ind. (London) *65:* 8 (1946).
91. HAWTHORN, J., and TODD, J. P. J. Sci. Food Agric. *6:* 501 (1955).
92. MARTIN, A. J. P., and SYNGE, R. L. M. Biochem. J. *35:* 1358 (1941).
93. OLCOTT, H. S., and MECHAM, D. K. Cereal Chem. *24:* 407 (1947).
94. RANK, J., and HAY, J. G. B. P., 646, 311 (1950).

## A.A.C.C.

# LOCAL SECTIONS

Niagara Frontier Section's February meeting, on the 11th, had as speaker J. Walters of National Analine on the subject, "Synthetic foams," accompanied by a demonstration and a film.

• • • •

New York Section's plans for their January meeting were changed too late to notify this office. Instead of Lawrence Zeleny, whose talk was rescheduled for the February meeting, Charles S. McWilliams, Chief of Cereal and Baked Products Section, QM Food and Container Institute, was speaker. Mr. McWilliams outlined the progress and development made in supplying food to the armed forces, from Civil War times to the present and including research now being carried on in irradiation of foods, freezing, precooking, and dehydrating, as well as in packaging.

• • • •

Northwest Section held its usual monthly luncheon meeting on January 25 with Atherton Bean, President of International Milling, speaking on "A businessman's view of cereal chemistry."

For its February meeting, Dr. Max Schultze, Professor of Agriculture Biochemistry, University of Minnesota, addressed the Northwest group on "The biological value of protein." The subject was chosen because of the recent concern on amino acid imbalance and its relationship to the possibility of using amino acids to fortify cereal protein.

• • • •

Nebraska Section has lost four members who moved to Cincinnati, Ohio, recently with the D. H. Foods Company. They are Arlee A. Andre, Joe D. Roshone, Duane R. Swenson and Vernon I. Eklund. Mr. Eklund was chairman of the section. Accordingly, an acting chairman has been elected — Paul J. Mattern, University of Nebraska College of Agriculture, Department of Biochemistry and Nutrition.

• • • •

Northern California Section met on December 5 in Spenger's Fish Grotto, Berkeley, California. The speaker was John Blum, Director of Research for Durkee's Famous Foods. His subject was "Properties of Edible Fats."

• • • •

At its January 7 meeting in Chicago, members of Midwest Section heard Robert M. Kark, Professor of Medicine, University of Illinois College of Medicine, talk on the rising incidence of coronary heart disease in North America. Dr. Kark announced his subject as "Eskimos, Bantus, and Americans, or How to Stay Young," and pointed out possible interrelationships between diet, exercise, blood cholesterol, arteriosclerosis, and coronary heart disease.

• • • •

For the March meeting of the Midwest Section, Lawrence Zeleny will address the group on the subject of wheat grading factors and will also discuss association affairs and prospects for the annual meeting in San Francisco in May.


**If your product contains fats or oils you should know about Myverol Distilled Monoglycerides**

*Myverol® Distilled Monoglycerides* is our name for our food emulsifiers that consist of practically all monoglyceride and practically no soaps, catalysts, or free fatty acids. "Myverol" is our trademark. "Distilled" means we produce them by molecular distillation, which is what achieves this exceptional purity. The "Monoglyceride" can come from any food fat, cottonseed oil to prime steam lard.

There's no food emulsifier quite like Myverol, nothing that acts quite the same. For example:

IN CAKE MIXES—with *Myverol* you can add the emulsifier separately, use it to compensate for variations in ingredients.

IN PEANUT BUTTER—you can use *Myverol* as a stabilizer to protect against "oil-out," to give a smoother-spreading product with less stickiness to tongue and palate.

IN HOUSEHOLD SHORTENING—very low levels of *Myverol* do a real job. You can use them after deodorization, and they keep the product in good working condition long after it reaches the kitchen cupboard.

IN ICE CREAM—*Myverol Distilled Monoglycerides*, along with an appropriate stabilizer, can be used to control overrun, produce a product with excellent dryness and melt-down.

In other products, too, like baker's shortening, chocolate coatings, and margarine, *Myverol Distilled Monoglycerides* can make a real contribution to product quality. We'll be glad to work it out with you. To get started, write ***Distillation Products Industries,*** Rochester 3, N. Y. Sales offices: New York, Chicago, and Memphis • Gillies Inc., Los Angeles, Portland, and San Francisco • Charles Albert Smith Limited, Montreal and Toronto.

*distillers of monoglycerides made from natural fats and oils*

DPi

Also . . . vitamin A in bulk for foods and pharmaceuticals

**Distillation Products Industries**
*is a division of* **Eastman Kodak Company**

### . . . People

**J. Ansel Anderson,** chief chemist of the Board of Grain Commissioners for Canada and director of the Grain Research Laboratory will be awarded the AACC's Thomas Burr Osborne Medal at its San Francisco meeting in May.

The award was founded by the AACC in 1926 to recognize "distinguished contributions in the field of cereal chemistry" and was named after the outstanding protein chemist, Thomas Burr Osborne. The medal has been awarded only nine times previously during the 31 years of its existence.

**Charles E. Brockway** named head of a research group at A. E. Staley Mfg. Co., Decatur, Ill.

**Allan J. Greene** named to the new post of administrative vp of Chas. Pfizer & Co. and a member of the executive committee.

**W. F. Geddes,** head of the department of Agricultural Biochemistry, University of Minnesota, is enjoying an extended vacation in the warmer climate of the Southwest. He will be away from his desk until April 1.

**Henry A. Lepper** retires from Food & Drug Administration after 43 years of service; has been asisstant chief of division of food since 1952.

**W. O. S. Meredith** will attend the European Brewery Convention in Copenhagen, Denmark, June 2-7, and will present a paper on new pilot malting equipment.

**C. W. Ofelt** joins DCA Food Industries Inc. (formerly Doughnut Corporation of America) as director of bakery products laboratory in the new Central Research Laboratories, New York. Dr. Ofelt was formerly with Northern Regional Research Labs., U.S.D.A.

**Robert Schwandt** promoted to assistant superintendent in the dry starch department, A. E. Staley Mfg. Co.

**Leonard J. Swicklik,** leaving U.S. Army service, accepts position as research chemist for Distillation Products Industries, Rochester, N.Y.

### . . . Products

Pink wheat, seed wheat treated with mercuric compound to control seed-borne diseases, has long been a problem for farmers and warehousemen. Only a few kernels of the poisonous pink wheat in a carload will cause the entire carload to be condemned. The United States and Canadian Governments have warned farmers that it is illegal to market such grain and that violations result in heavy penalties.

However, grain inspectors have found it extremely difficult to pick out a small amount of pink wheat mixed in a carload of commercial grain. But when they passed carload samples under Blak-Ray ultraviolet (black) light, they discovered that the pink wheat kernels fluoresced a bright orange color and could be detected immediately.

The Blak-Ray Model X-4, as used by Union Equity Cooperative Exchange of Enid, Oklahoma, is mounted over a belt cranked by hand to pass the wheat kernel samples under the ultraviolet rays. Wheat is poured into a dispenser above the belt and caught in a tray at the belt's end. Even the smallest amount of contaminated wheat is detected by this method.

• • •

Publication of Volume 15 of the **Encyclopedia of Chemical Technology** (Interscience: New York) completes an enormous project, which was thirteen years in the making. There are 13,805 pages of text, and an index occupying most of the final volume. More than 1000 authors contributed over 800 articles to this exhaustive compilation of American technical practice in chemistry. The demand in other countries for American "know-how" has been reflected in a wide distribution of the encyclopedia in many foreign countries.

The information is to be kept up to date by supplement volumes.

### . . . Patter

The Sixth International Congress of the European Brewery Convention will be held in Copenhagen, Denmark, from Sunday, June 2, through Friday, June 7. The program for Monday through Wednesday will be taken up with a series of papers; the general meeting of the Convention will be held on Thursday; and visits to breweries are scheduled for Friday.

• • •

In order to meet the needs of its growing and diversified activities, DCA Food Industries, Inc. (formerly Doughnut Corporation of America), has expanded its Central Research Laboratories in New York, as annonuced by Zenas Block, vp of planning and research. David H. Schwartz is manager and director of quality control.

• • •

A "Symposium on future developments in food preservation" (April 2-3 in Kansas City, Hotel Muehlebach), sponsored by Midwest Research Institute, will interest producers, processors, equipment manufacturers, home economists, and people in food service. The first day's program will cover expected future developments in food preservation and packaging–refrigeration and freezing, dehydration, dehydro-freezing, heat sterilization, high-energy sterilization, and chemical preservation. On the second day, the program will cover economics and home economics, nutrition, public health, and other physiological considerations. Further information can be had from the sponsor: Write to Food Symposium, Midwest Research Institute, 425 Volker Blvd., Kansas City 10, Mo.

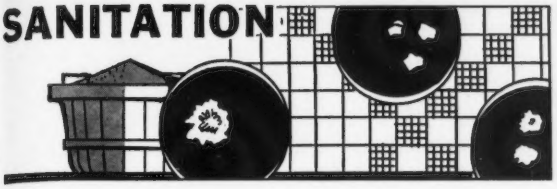
## EMPLOYMENT NOTICES

**MICROSCOPIST – HISTOLOGIST**

**A career opportunity is now open in the Development Laboratory of a leading soybean processor and major feed manufacturer. Degree in chemistry, bacteriology, biology, or botany required. Work is in the field of feed microscopy and photomicrography. Responsibility for small histological laboratory dealing with problems of product and chemical development, also special projects of microbiological and bacteriological nature. For complete details write:**

**Paul E. Hensel**
**Vice President, Personnel**
**CENTRAL SOYA COMPANY**
**300 Ft. Wayne Bank Bldg.**
**Ft. Wayne, Indiana**

## SANITATION



### *AMERICAN CORN MILLERS FEDERATION . . .*

During the week of January 13 the American Corn Millers' Federation held a seminar on extraneous materials in corn and corn meal. Present at the meeting, held in Chicago, were 26 representatives from various mills, cereal food manufacturers, commercial laboratories and sanitarians, state chemists and the U. S. Food and Drug Administration. The discussion of analytical problems in this field was led by the two FDA men present — K. L. Harris and O. L. Kurtz — and various mill representatives were part of the panel of discussion leaders.

The subject matter included the morphology of adult insects as it contributes to a better understanding of insect fragment identification; morphology of larval insects as they are contributors of insect fragments in cereal products; and the identification of insects from the micromorphology of insect fragments found in cereal products. Material was covered on the use of the microscope, extraction techniques, rodent hair identification, and raw materials control. Insect fragment counts were made on prepared material, and comparisons were obtained on such counts by those participating in the seminar.


**KEL-PAK**

*powders*

Speed Kjeldahl digestions with Kel-Pak Powders.

The powders are complete precision blends of nitrogen-testing chemicals of fine quality. Ready to use, they are packaged in inert, foam reducing, airtight polyethylene bags.

These powders permit you to run Kjeldahl determinations with greater precision, at a great saving of time.

The powders conform to the standard methods of the A. O. A. C.

Five standard formulas are available.

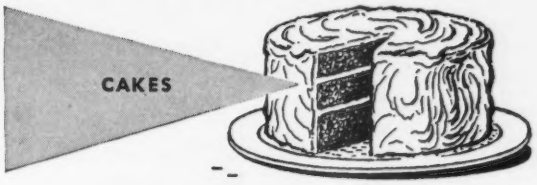
They are packed in boxes of 1000 packets. The minimum shipment is 500 packets. They are not mailable.

**KANSAS CITY**
*Laboratory Supply Co.*

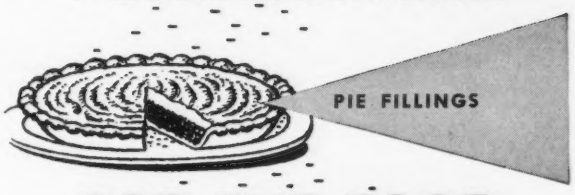
307 Westport Road Kansas City 11, Missouri
Telephone JEfferson 1-7745



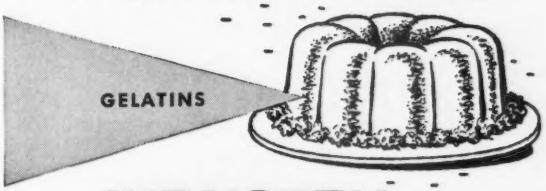
**FINE FLAVOR**



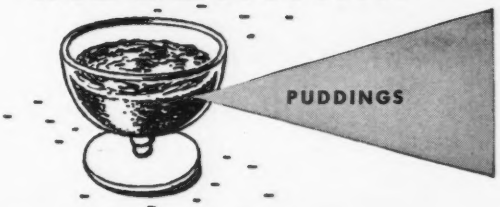

**FORMULATIONS**




**FOR THE FOOD**




**INDUSTRY.....**




# FRIES & FRIES

*flavors*

**Developing new and distinctive flavors or supplying established ones are equally important at Fries and Fries.**

**Our modern flavor laboratories are staffed with highly skilled chemists and technicians who have helped perfect the flavorings of many fine products found on every supermarket shelf.**

***Your inquiry will be given prompt attention and treated in strict confidence.***

MANUFACTURING CHEMISTS
FRIES & FRIES
INC.
CINCINNATI
U.S.A.

**NEW YORK • 418 E. 91st St. • SA 2-2260**
**CINCINNATI • 110 E. 70th St. • VA 1-7200**

# Observations

For a number of months we have been discussing various new methods of analysis that have come to our attention for possible use in the cereal laboratory. Flame photometry analysis of trace minerals in feeds and foods seems interesting.

In our new laboratories we have made provision for a number of these methods to receive special attention so that they might be developed for routine analytical work sometime in the future. Only in this manner can a true commercial laboratory give the type of service expected.

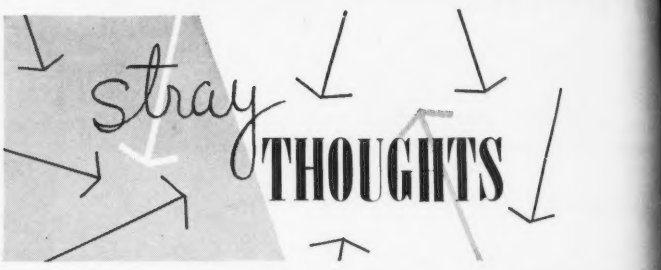
Elsewhere in this issue you'll find an excellent review of some seven or eight new analytical techniques that can be employed by the cereal chemist. Most of these methods have been applied to cereal or other food products and a convenient bibliography is provided. It is hoped that AACC members and others in the cereal field will give serious thought to trying some of these methods in their own laboratories. We feel that progress in our industry is closely related to progress in the laboratory and that the stepping stone is an easy but precise analytical method.

As we have often stated in this column, our prestige and our Association move ahead only as we accept responsibility and seek new ways to accomplish old desires. This laboratory is always ready to cooperate in any such venture.

Jim Doty

DOTY Technical Laboratories

1435 Clay St.,
North Kansas City 16, Mo.
MILLING FEED ANALYSIS
VITAMIN ASSAYS
BAKING SANITATION




## DR. J. HAWTHORN

The author of our excellent article on modern methods of chemical analysis is an honors graduate in chemistry. He spent six years in the food industry gaining experience in canning, quick-freezing, dehydration, and meat packing. Recently he was appointed Principal Lecturer in Food Science at the Royal Technical College, Glasgow and has taken charge of new laboratories for the study of this subject.

His research interests include the field of the unsaturated-fat oxidases, protein oxidations, and the contamination of foods with radio-active materials.

Readers interested in obtaining a list of American companies manufacturing equipment described in Dr. Hawthorn's article may write the Managing Editor.

## PRELIMINARY PROGRAM

Between pages 54 and 55 of this issue, readers will discover a blue, 4-page insert, consisting of the AACC's preliminary program for the 42nd Annual Meeting. The insert is not numbered and therefore, can be removed for easier reference without disturbing the rest of the journal.

Normally, this program is mailed to AACC members only, but this year it was decided to give nonmembers of the association an opportunity of examining the excellent papers being planned for the May meeting in San Francisco.

This is the first national meeting the AACC has ever held on the West Coast. Because of this, interest is running high and the attendance is expected to be quite good. Many members we have talked with are planning to bring their families along and combine business and pleasure. The lure of San Francisco is just too great for the ladies to stay home, and we don't blame them one bit.

We've had advance word on the entertainment and must confess our anticipation of the meeting has been increased tenfold. You'll be pleasantly surprised and we hope delighted at headliners the Local Arrangements Committee has contracted. But more on this next month.

## FDA TO BAN FOUR FOOD DYES

The FDA has announced recently that FD & C Yellow Nos. 1, 2, 3, and 4 will be banned from the certified list of accepted food colors. Chronic toxicity studies with animals, says FDA, show these colors could be harmful if used in large amounts. Color manufacturers, food processors, and others have 30 days in which to file written complaints with the government on the proposed ban.

The February 4 issue of *Chemical and Engineering News* has a full account of the FDA action on page 32. The article gives some pertinent background and comments on industry reaction.

## AACC MEMBER IN INDIA

An extremely interesting letter was received the other day from C. C. Fifield, now in New Delhi, India. Mr. Fifield writes that he is busy setting up a chemical, milling, and baking laboratory for the Indian Agricultural Research Institute at New Delhi.

He says, "This is a most interesting country. I attended a Folk Dance Festival last week and got close-up shots of Mr. Nehru and Marshal Zhukov who is on an official visit here. Only hope that I will have an opportunity to show my pictures when I return." If Fifield's friends wish to write, the address is: American Embassy, New Delhi.